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VECTOR DIAGRAMS.

The two papers presented before the recent meeting of the American Institute of Electrical Engineers by Prof. W. S. Franklin and Prof. Ernst J. Berg, present in a very forceful manner the arguments in favor of the two methods in general use for the representation of alternating quantities. Professor Berg's examples show very clearly that the best idea of the instantaneous values of the quantity in question can be obtained, especially in the case of non-harmonic quantities, by a representation in which the values are read off directly on one of the co-ordinates; this may be the radius vector in a polar diagram or the ordinate in a rectangular system. Although Professor Berg favors the polar diagram there seems to be little choice between these two. This argument refers, however, only to the graphical representation of the quantities considered and tacitly passes by the question of representing the quantity by a single stationary line designated as its vector. It is at once acknowledged that such a vector cannot, if restricted to one plane only, represent a harmonic quantity; that is, one which follows the sine law of variation. Undoubtedly for one with only ordinary mathematical preparation it is useless to attempt the representation of any but harmonic quantities by vectors, unless one is willing to make use of the equivalent values.

On the other hand, where one wishes to represent a great many different quantities in the same diagram the polar curves are likely to become confusing and the diagram is rendered more simple if each quantity can be represented by a single straight line. This is what is done in the ordinary vector diagram, and while the projection must be made to get the instantaneous value of any quantity, it is unnecessary to carry out these projections in determining the relations of the different vectors and in making graphical combinations of those representing quantities of the same kind, say, voltages.

Professor Franklin's arguments seem to make it clear that if vectors are to be used in this way it is more logical to represent them by the method in which a lagging current follows and does not precede the corresponding electromotive force, regarded in the direction of positive angles. The positive direction is conventionally taken the same by all.

ELECTRIC SHIP PROPULSION.

The paper by Mr. W. L. R. Emmet on "Proposed Applications of Electric Ship Propulsion," presented at the mid-year convention of the American Institute of Electrical Engineers and appearing in abstract on another page of this issue, is a valuable and significant contribution to the cause of electric ship propulsion. The use of electric motors to propel ships at first seems inappropriate since with such a method the power of steam must first be converted into mechanical work, then into electricity and then again back into mechanical work. All these processes involve appreciable percentages of loss and it is only by the careful analysis of all of the features that the relative desirability of such an undertaking can be ascertained.

There have been a few examples of motor applications in marine work, the results of which have been encouraging. The work has only been tried out, though, on a small scale. Mr. Emmet's paper, however, deals with the more important problem of the propulsion of very large vessels by steam turbines with generators and motors as the reducing gear and his data assumes a new light because of the fact that his theories are applied to an actual design of a battleship.

It is primarily for the sake of speed reduction that electricity is advocated for the propelling force. The efficient speed of the steam turbine is very much greater than the efficient speed of a propeller adapted to absorb the same power. To get the best work out of a turbine its speed should be at least three or four times that ordinarily used in marine work and of course direct connection of the propeller at these speeds prohibits an efficient working of the turbine. It is of course feasible and something has already been accomplished in the matter of using the Melville-Macalpine mechanical reduction gear. Recent installations would seem to indicate that much can be looked for in this direction. However, a comparison of the two methods would probably show that while both would admit of a great reduction in weight, the electric drive certainly offers greater flexibility in speed control. In the case of electric drive it has been proved by application to other arts that certain results can be accomplished in a thoroughly reliable manner.

One of the important advantages of electric propulsion as compared with other possible methods of speed reduction lies in the fact that arrangements can be made by which the ratio of the reduction is changeable so that the turbine may be run at its most effective speed under more than one condition of the vessel's operation. The possibility of such a change in speed ratio is particularly valuable in connection with warships, since such vessels need very high speed for emergency conditions and also need to operate economically at low speed so that their radius of action may be made as wide as possible.

In the design proposed by Mr. Emmet it is possible for both of the propeller motors to be operated from one generating set. This is accomplished by reducing the speed of the turbines sufficiently to disconnect one of the generators and two of the motors. When the speed has fallen sufficiently low a still further gain can be accomplished by connecting the remaining motors for fifty poles instead of thirty poles. It is apparent that these conditions are ideal for cruising and the economy afforded will increase the military value of a vessel so equipped.

ELECTRICITY IN MINES.

The American Mining Congress appointed some time ago a Committee on Standardization of Electrical Equipment in Coal Mines, and this committee has now made a report, as is noted in our column of NEW PUBLICATIONS. The report consists of a proposed code of rules, including special provisions governing electrical practice in gaseous mines.

The number of fatal accidents due to the use of electricity in mines is not a large percentage of the total number due to all causes, but this does not mean that sufficient attention has been given to modes of prevention, since electrical accidents are largely preventable, and efforts in their elimination should not be abated until the percentage is nil. A great many installations and a great deal of the operating practice in this country is not attended with that regard to simple precautions which should always obtain where human lives are put in jeopardy. That some code of rules should be drawn up, and enacted into law, to govern mine operation, is generally admitted by those familiar with the conditions. As in other matters of legislation it is highly desirable that a uniform code be adopted in the different states, the rules being so drawn as to cover the variations in local conditions. The rules should be made to apply to metalliferous mines as well as to coal mines, there being no essential difference in the conditions, except where the coal mines are gaseous.

The principal dangers arising from the use of electric current in mines are shock and the ignition of inflammable or explosive materials by sparking. To obviate the first, low or medium voltages should be used in all apparatus, high voltage being confined to transmission lines. Leakage must also be carefully guarded against, as the conditions in mines are especially favorable to it.

To avoid danger from sparking, all motors with commutators should be inclosed and should be flame-proof. Switches, fuses and movable apparatus must be surrounded with especial precautions.

Above all, after proper equipment is properly installed, it should be regularly and efficiently inspected. The experience in England may prove helpful in this regard.

The code which has been in force in England was put into effect in 1905 by the British Home Office. It has been considered necessary to bring these up to date, and a new

code has been drawn up by a committee appointed in 1909 by the Home Office. In its report this committee states that nearly all trouble has arisen from either faulty mechanical construction and design of apparatus or from insufficient supervision and maintenance. The former source of trouble should be obviated by sufficiently stringent rules requiring improved design and construction. Much progress has been made in the design of equipment especially suited for mining purposes, but there is still room for improvement, more especially with respect to the mechanical details of switches, cables and minor apparatus. Avoidance of sparking and the minimum exposure of live parts are two great desiderata.

Maintenance in proper condition, under the severe conditions imposed underground, can only be guaranteed by adequate, intelligent, conscientious and regular inspection. An existing rule in England reads: "A competent person shall be on duty at the mine when the electrical apparatus or machinery is in use." In the opinion of the committee on revision, above referred to, this provision is too vague, and the qualifications of the mine electrician should be specified and cover not only technical knowledge but character, resourcefulness and conscientious devotion to duty. It is hard to set any test of the latter, further than the judgment of the mine superintendent, which renders inspection from an outside source all the more necessary.

In most of our states we already have provision for regular mine inspection, but the inspectors are not usually competent to pass upon electrical apparatus. It therefore seems desirable to supplement the inspecting force by men trained in electrical matters sufficiently to determine whether the rules are being complied with. It will be recalled that a similar code of proposed rules was recently issued by the Bureau of Standards (Circular No. 23, July 15, 1910; see ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, November 12, 1910) in which this feature was incorporated, and it would seem highly desirable that the American Mining Congress should incorporate this provision in any code which it may finally adopt or propose to the States for enactment into law. England's experience in this matter should not be wasted upon us, and it is probable that our present inspectors of mines in the various states could furnish interesting testimony on this point.

Otherwise the two codes are very similar, covering substantially the same ground. In connection with a provision for sprinkling to prevent explosive accumulations of coal dust, the suggestion made elsewhere in this issue for the use of soap and water in place of plain water should receive consideration. It is claimed that the addition of soap causes the lumping of the dust and prevents its formation anew upon drying.

In conclusion, reference may be made to the statement of the English committee on revision that "experience has shown that the proper use of electricity cannot be regarded as inherently unsafe and that it possesses some characteristics of great advantages in underground conditions."

DAY LETTERGRAMS.

The conspicuous success which has attended the introduction of the night lettergram has established this feature as a permanent characteristic of telegraphic service. Not only has the service proved a boon to the customary users of the telegraph, but it has attracted traffic from hosts of others who did not ordinarily use this service and incidentally it has proved a very attractive means of increasing the revenue of the telegraph companies.

The announcement is made that beginning with March 1, the Western Union Telegraph Company inaugurated a day lettergram service. These day letters cost about one and one-half times as much as the night letters, which were put in force about a year ago.

When the announcement of the alliance between the American Telephone & Telegraph Company and the Western Union Telegraph Company was made, Theodore N. Vail stated that very radical steps would be taken to improve the efficiency of both the telephone and telegraph service, and that through the co-operation of traffic arrangements on both arms of the service economies would be effected and operating efficiency improved.

This policy has been consistently adhered to and within the very short time which has elapsed since then there have been witnessed several most important improvements which have attracted new business to the companies and been of incalculable value to the users of the service.

ENGINEERS OPPOSED TO LICENSING LEGISLATION.

There are three bills pending in the Legislature of the State of New York proposing the restriction of the professional activities of engineers and requiring a sort of civil service examination on the part of those who undertake work of this character in the State of New York unless they have been practicing there for a considerable term of years. It is understood that the national organizations representing the mechanical engineers, the civil engineers and the electrical engineers, and in fact all the leading engineering talent of America, are opposed to these bills. Committees of these organizations are hard at work and it is purposed to make a strong protest at Albany at the hearings.

On another page of this issue we reproduce the report of the special committee appointed by the directors of the American Institute of Electrical Engineers to investigate the subject matter of the proposed acts and to confer with other professional and learned societies.

It appears that after careful analysis and investigation the committee is positively of the opinion that the passage of any or all of these bills is against the best welfare of the people of New York and that they do not represent any substantial public demand or need.

Convention of Mechanical Engineers.

The sixty-third meeting of the American Society of Mechanical Engineers will be held in Pittsburg, Pa., from May 30 to June 2, under the presidency of Col. E. D. Meier, of St. Louis.

A committee consisting of E. M. Herr, chairman, George Mesta, J. M. Tate, Jr., Chester B. Albree, D. F. Crawford, Morris Knowles and Elmer K. Hiles, secretary, will have charge of the Pittsburg meeting.

It is expected that from 300 to 400 members and ladies will be in attendance. In addition to the professional sessions, when papers will be read and discussed, there will be inspection trips to the leading local industrial establishments, besides automobile trips through the parks and visits to Carnegie Institute, Memorial Hall, etc.

New Value for Weston Cell Used in England.

The London *Electrician* states that the National Physical Laboratory is now issuing certificates for standards of voltage based upon the value 1.0183 volts at twenty degrees centigrade for the standard Weston cell. This is in conformity with the action taken by the national standardizing laboratories of Germany, France and the United States.

Oklahoma Telephone Association.

The Oklahoma Telephone Association, which met in Oklahoma City on February 14, elected for the ensuing year the following officers: R. S. Goff, of the Sulphur Telephone Company, president; I. H. Strickland, of the Stonewall Telephone Company, vice-president; Horace Truman, of the Geary Telephone Company, secretary-treasurer.

The committee on arrangements of the next meeting, which will be held in Oklahoma City the second Tuesday in August, is composed of L. A. Smith, Horace Truman and H. Sullivan.

German Effort to Extend Use of Electricity.

An association has been formed in Germany for the purpose of promoting the consumption of electrical energy. An extensive propaganda will be inaugurated at once. The managing committee comprises representatives of central stations, manufacturers, contractors and engineers.

Day-Wire Letters.

Beginning with March 1, the Western Union Telegraph Company inaugurated a day letter system. These day letters cost about one-and-one-half times as much as the night letters, which were put in force a year ago.

Boston Edison Vehicle Campaign.

The Edison Electric Illuminating Company of Boston has started a one-hundred-thousand-dollar campaign of education for the use of electric vehicles in the five hundred and fifty square miles of territory covered by its lines. The Company has recently purchased thirty-four electric pleasure and commercial vehicles and will replace approximately one hundred and twenty more of its horses and wagons.

CHARLES L. EDGAR.
Who Is Pushing the Vehicle Campaign.

horses and buggies, and thirty-nine gasoline cars with electrics. Orders will be distributed among different manufacturers. Purchases will be made only from those manufacturers who are adequately and substantially represented in Boston. The Company is equipping and will operate a public garage under the auspices of the Electric Vehicle Association of America. A low rate for complete service, including charging current, irrespective of daily mileage, will be offered.

The campaign was inaugurated at a dinner and conference in Boston on March 3 given by the Edison Electric Illuminating Company. Seventy-five electric-vehicle companies, motor manufacturers and allied industries were invited. The Boston Automobile Show opens on March 4 and every inch of space has been sold. The exhibition space is fifty per cent larger than that at the New York show, and the overflow fills Horticultural Hall completely.

Chicago Rules for Rubber-Covered Wires.

The Department of Electricity of the City of Chicago has announced that after April 1, 1911, no rubber-covered wire will be approved for use in that city which does not meet the specifications to be put into effect in New York City on the same date. These specifications were given in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for January 21, 1911.

Frequent tests will be made upon the wire used in installations in Chicago to determine whether it complies with the specifications.

The announcement is made by William Carroll, city electrician.

Swedish Hydroelectric Power Station.

The Swedish Government is preparing a scheme for the erection of a hydroelectric power station at the Aefkarleby Falls, on the river Dal Elf, a few miles from its mouth, at which point the stream is divided by islands into three branches. The hight of the falls is about fifty feet. It is proposed to build the station in three installments, during which its capacity will increase from 18,000 horsepower to some 45,000 horsepower. The geographical position of the falls is regarded as quite satisfactory, as there are several towns of some importance within a limited radius.

New York Electrical Society.

The next meeting of the New York Electrical Society will be held at the Hispanic Society Building, 156th Street near Broadway, New York, on the evening of Thursday, March 16. F. O. Blackwell, the well known engineer, will give an illustrated lecture on hydroelectric developments in Mexico.

Reception and Dance of American Instute of Electrical Engineers.

The reception and dance of the American Institute of Electrical Engineers, which was held at the Hotel Astor on February 28, was a distinguished success. The reception and dance is a new feature and this year took the place of the annual dinner. There was a large gathering and many of the best known representatives of the electrical industry were present. Badges were presented to past-presidents by President Jackson, and the reply was made by T. C. Martin.

Sir William Ramsay.

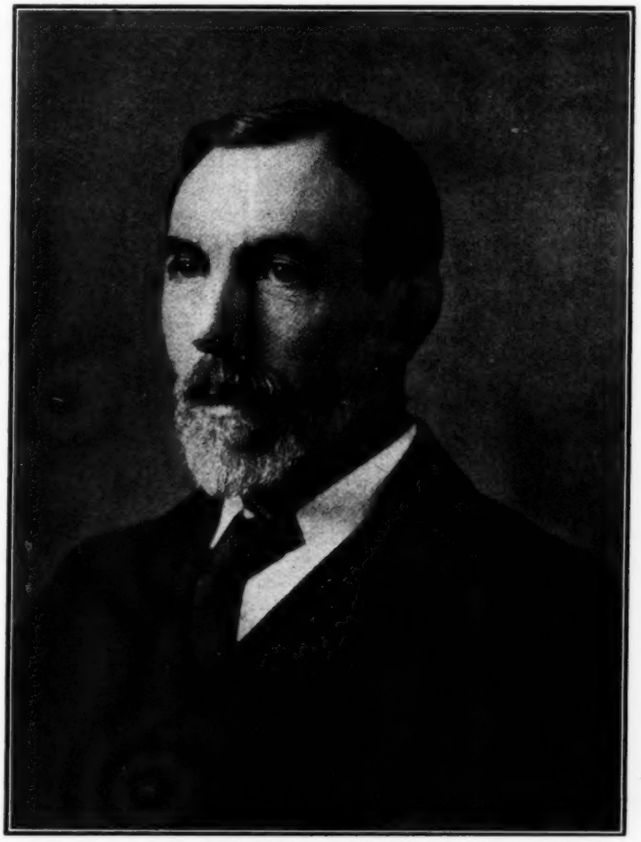
It is not so many years since the scientific world was startled by the announcement of the peculiar characteristics of radioactive substances. The discoveries in physical science contingent upon the development of knowledge of these substances have contributed to a rapid unfolding of many problems which have heretofore been considered chemical mysteries.

Among the brilliant men who have been engaged in the pursuit of information respecting the chemistry of radioactive substances, the subect of this sketch, Sir William Ramsay, has taken a most prominent part.

Sir William was born at Glasgow, Scotland, October 2, 1832. His grandfather was a very prominent chemist, and founded, in 1800, the Glasgow Chemical Society of which he became the first president. His father was a civil engineer and brother to Sir Andrew Crombie Ramsay, who was president of the Geological Society, 1862-1864, and president of the British Association, 1860.

Sir William entered Glasgow Academy at an early age, remaining there until his fifteenth year when he entered Glasgow University. He commenced his studies of chemistry under Professor Anderson, following laboratory work under Mr. Tatlock, a well known analyst of the time. In 1871, he went to Tübingen to study chemisty under Professor Fittig, and from the time of his graduation there as Doctor of Philosophy in 1872, until 1874, he acted as chief assistant to the Young Chair of Technical Chemistry in Anderson College, Glasgow. In 1880 he accepted the post of tutorial assistant in the chemical department of Glasgow University, later being appointed professor of chemistry in the University College of Bristol. He became principal of this institution one year later, retaining both posts until 1887, when he was elected to the chair of chemistry in University College, London. It was soon after this attachment that he turned his attention to physical chemistry, and in conjunction with Professor Sydney Young began the work which has resulted in the splendid achievements which have been heralded throughout the scientific world.

During 1894, Sir William and Lord Rayleigh discovered the element argon. The existence of this element had first been suspected by Cavendish during his lifetime—1731-1810—but had not attracted much subsequent attention.



SIR WILLIAM RAMSAY,
Discoverer of Transmutation of Radium.

Their joint discovery was made known to the public at the British Association meeting held at Oxford. In 1895, Ramsay obtained from a mineral called cleveite, another gaseous element, helium. This discovery resulted from a number of investigations which Sir William carried out in the expectation of finding a substance containing argon combined with other elements and of thereby ascertaining more information respecting its chemical properties.

Professor Ramsay discovered, in conjunction with Dr. Travers, during 1898, three more gaseous elements which have been called neon, crypton and xenon.

In conjunction with Frederick Soddy, Professor Ramsay has found that radium in its apparent disintegration evolves helium. During 1903, Sir William and Mr. Soddy made the very important discovery that helium is developed by a spontaneous change in the radium emanation and four years later Sir William and Mr. Cameron further proved that neon and argon are likewise produced from the radium emanations.

Sir William held the presidency of the Bristol Naturalists' Society from 1884 to 1887. He was president of the chemical section of the British Association meeting held at Toronto during 1897, and he is a fellow of the German Chemical Society, as well as of the Royal Medical and Chirurgical Society, the Pharmaceutical Society, the Chemical Society, Physical Society and Royal Society of London, and a member of other scientific organizations. He is a member of the Royal Academies of Berlin, Holland, Ireland, Bohemia, Rome, St. Petersburg, Rounania, Vienna, Norway and Sweden, and of the Academies of America, Geneva, Frankfort and Mexico. In 1895 he was decorated an officer of the Legion of Honor and has since been made a Commander of the Crown, of Italy. He is a foreign member of the Institute of France, and honorary LL.D. of Glasgow and Birmingham, and honorary D.Sc. of Dublin, Oxford, Cambridge, Liverpool and Columbia, Ph. D. of Tübingen and Krakau, and an M. D. of Heidelberg and Jena. He was created K. C. B. in 1902.

Sir William divided with Lord Rayleigh the Hodgkins prize of $10,000, offered by the Smithsonian Institution of Washington, D. C., as well as the Lecompte prize of 50,000 francs awarded by the Paris Academy of Sciences. He has besides received the Barnard medal of the American Academy, the Davy medal of the English Royal Society, the Longstaff medal of the English Chemical Society, the LeBlanc medal of the

French Chemical Society, and the Hoffmann medal of the German Chemical Society, in addition to one of the Nobel prizes given for chemistry.

He has been a frequent contributor to the technical literature of the various subjects upon the study of which he has been engaged, and as an instructor and educator has been remarkably successful.

Meeting of Cleveland Section, A. I. E. E

On February 20, the Cleveland Section of the American Institute of Electrical Engineers held its regular monthly meeting. After supper at the Rathskeller, the members met in the Engineering Building of the National Electric Lamp Association, as guests of the latter, and listened to three papers on subjects pertaining to electric illumination. The first was by H. T. Spalding on "Mazda Street Lighting," the second by P. W. Cobb on "The Physiology of Glare," and the third by Herbert E. Ives on "The Production of Artificial Daylight."

Mr. Spalding presented numerous stereopticon views of various types of street lighting fixtures and installations. Dr. Cobb discussed the effect of scattered light in the eye in diminishing sensibility. Dr. Ives discussed and demonstrated the additive and subtractive methods of producing light of the color known as "average daylight." He produced light of this color, using the additive method, by adding light from a tungsten-filament lamp to that from a mercury-vapor lamp, in the proportions of one to two, approximately. Using the subtractive method, he cut off from the light of a tungsten-filament lamp by means of a selective screen, just enough light of the longer wave lengths so that the transmitted light had the color of average daylight.

After the meeting a light lunch was served in the employees' restaurant.

Congress of Technology.

What promises to be a very remarkable and striking record of the place of science in modern industry will be presented in the series of papers which will constitute one of the main features of the Congress of Technology to be held in Boston on April 10 and 11, this year. The first of these dates is the fiftieth anniversary of the chartering of the Massachusetts Institute of Technology, and the primary purpose of the Congress is fittingly to mark that anniversary. A large number of Technology graduates who have been conspicuously successful in varied lines of engineering will present papers at the Congress, dealing with various aspects of the country's manifold industrial problems and treating of those problems not only as they exist now but as they promise to take shape in the future. The papers, separately, will discuss the conditions and prospects in specific industries and will, therefore, be of exceptional interest to the great number of men engaged in them.

Agreement Between Marconi and Telefunken Companies.

An agreement has been entered into between the Marconi Wireless Telegraph Company, the Telefunken Company, the Gesellschaft für Drahtlose Telegraphie, Braun, Siemens and Halske, and the Compagnie de Télégraphie Sans Fil, as a result of which a new operating company has taken over the contracts under which the two first-named companies had entered with the shipping interests. The rivalry which has previously existed between these two companies is therefore terminated. The new operating company will take over the stations as well as the personnel of the old companies.

Telephone Bill in Texas.

A bill has been introduced in the legislature of Texas with an idea of classifying telephone companies according to the class of service rendered rather than upon the size of the town. The bill provides for eight classes comprising cities of from populations less than 1,000 to those of more than 75,000. Companies are prohibited by the proposed bill from charging a higher rate of rental for exchange telephone service in any town or city of a lower class than is charged for like service in any town or city of a higher class.

Examination for Machinist.

An examination will be held on March 29 to secure eligibles for filling the position of machinist in the Signal Service at Large, Manila, P. I. Those wishing to take the examination should apply to the secretary of any board of examiners or to the United States Civil Service Commission, Washington, D. C., for examination blank 1312.

Close of Philadelphia Electrical Show.

The final week of the Philadelphia Electrical Show closed successfully on Saturday night, February 25. The week was marked by an increased attendance.

At a meeting of the exhibitors on Tuesday night, February 21, at which W. C. L. Eglin presided, matters in connection with future exhibitions of this sort to be held in Philadelphia were discussed.

Appreciation of the management's satisfactory and economical installation of exhibits was voiced by the exhibitors and the show pronounced a success. Among those who made remarks were Frank H. Gale, E. B. Stebbins, J. C. McQuiston, L. R. Newbold, John C. Gibson and G. S. Smith. It was decided to appoint a committee to consider ways and means looking toward a permanent show organization, together with possible co-operative features, and the chair appointed John J. Gibson chairman of this committee.

On Friday evening, February 24, a rejuvenation of the Sons of Jove was held at the Odd Fellows Temple, at which a large class was initiated.

Underwriters' National Electric Association.

The eighteenth meeting of the Underwriters' Electric Association will be held in New York City on March 22 and 23, and will consider committee reports and suggestions for changes in the National Electrical Code. The proposed changes will be considered by the Electrical Committee before the general meeting and recommendations made for adoption or rejection. Copies of the proposed changes and committee reports can be secured on application to Secretary C. M. Goddard, 141 Milk Street, Boston, Mass.

To Investigate Copper Companies.

A resolution has been introduced in the Senate authorizing the Attorney General to investigate the organization, methods of operation, and relation to each other and to allied companies, of the Amalgamated Copper Company, the Anaconda Copper Company, and the United States Metal Selling Company, for the purpose of determining whether they have formed a trust or combination in violation of the Sherman anti-trust law.

Rehabilitation of a Central Station.

Changes in the South Bend Plant of the Indiana & Michigan Electric Company.

A suggestive example of the co-ordination of water power and steam power in central-station service is afforded by the system of the Indiana & Michigan Electric Company, of South Bend, Ind. Although the communities supplied with energy by the Company are of moderate population, the area of the territory served and the location of the generating and distributing installations combine to form an engineering situation of considerable interest.

INTERIOR OF SOUTH BEND STATION DURING RECONSTRUCTION.

The Indiana & Michigan Electric Company operates four hydroelectric properties for supplying electrical energy. Two of these properties are located within the State of Indiana, one at Elkhart and one at Twin Branch, which is thre miles north of Mishawaka. The Company also operates two hydroelectric properties in the State of Michigan, one at Buchanan and one at Berrien Springs. About 22,000 electrical horsepower is developed from the St. Joseph River at these four points. The hydroelectric plant at Elkhart is capable of developing 2,000 horsepower, the plant at Twin Branch 7,000 horsepower, the plant at Buchanan 4,000 horsepower and the plant at Berrien Springs 9,000 horsepower. These plants are connected to high-tension lines which radiate from South Bend, Ind., and all lines, with the exception of those between South Bend and Mishawaka, are in duplicate. The transmission lines are virtually high-tension busbars with the different plants as different units, all radiating from a central substation at South Bend and all lines connected together through a high-tension switchboard in the South Bend substation. Thus all of the electric plants are working in parallel and the proportionate load to be carried by each is regulated from the South Bend substation. The South Bend substation adjoins the rebuilt steam auxiliary plant which is connected through step-up transformers in the substation to the high-tension bus and can be used to supply any shortage of power to any one or all points on the system. The lines leaving the substation from South Bend for the east and south have a voltage of 13,200, and lines leaving the substation for the north and west have a voltage of 25,000, and the two voltages are connected in at their proper points on a set of three auto-transformers connected in "Y," with their neutral point grounded. This ground limits the voltage rise on both of the systems, preventing any excess voltage strains at either transmission voltage from grounds or other troubles on any of the lines. The ground on the neutral point of these auto-transformers is the only ground on the high-tension system and with these auto-transformers, both the 13,200 and the 25,000-volt lines being connected to the same transformer coil, virtually makes the trans-

mission system continuous although of two voltages, and the energy loss in the auto-transformers is very small, being but .98 of one per cent, when 6,000 kilowatts is being transferred from one voltage to another on the system. These auto-transformers occupy very little room as they are oil insulated, water cooled, and they are also insulated for the maximum theoretical voltage strains which it is possible to get from this combination, not depending for any protection on the fact that the neutral point is grounded.

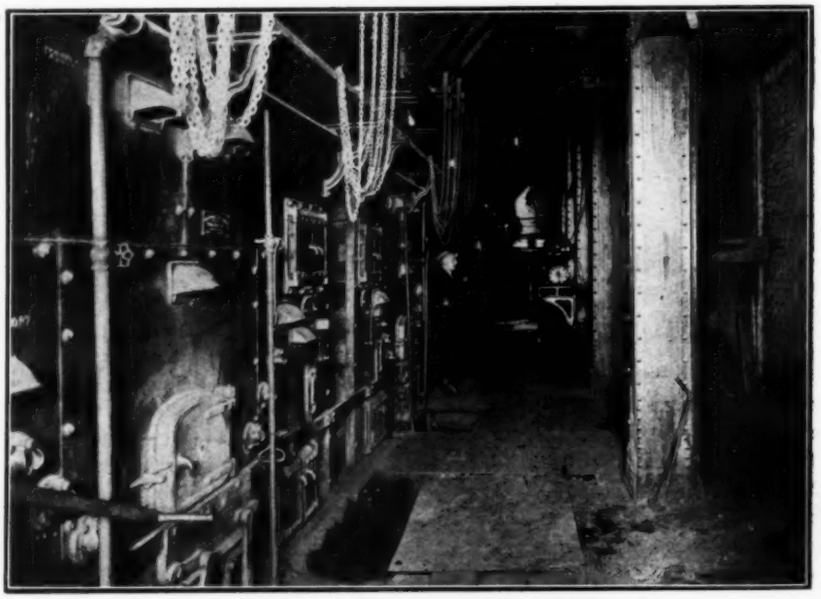
The power generated at these plants is used for street lighting, commercial and residence lighting, factory power and street-railway power. The transmission lines parallel the interurban railway lines of both the Chicago, South Bend & Northern Indiana and the Southern Michigan Railway Company, and power for operating their cars is supplied from substations at proper intervals, which substations are connected to both the transmission lines passing them. This connection to both transmission lines decreases the liability of break or any stoppage in the continuity of service. Each substation is equipped with sixty-cycle rotary converters and each rotary carries a slightly leading current which approximately offsets what would be the drop in voltage on the transmission line between two substations. This practically gives a flat voltage curve on the transmission lines.

Street lighting, commercial and residence lighting and factory power is supplied from the system for the cities of Benton Harbor, Mich., St. Joseph, Mich., Buchanan, Mich. South Bend, Ind., Mishawaka, Ind., and Elkhart, Ind., and substations for stepping down the voltage for the distributing systems in the aforementioned locations are also connected each to two high-tension transmission lines. The city railway service at Benton Harbor and St. Joe, South Bend and Elkhart is supplied from synchronous motor-generator sets, the synchronous motors of which are built for low power factors and from these sets sufficient wattless current is supplied for the transformers, etc., on the commercial distributing system so that the high-tension transmission line and the water-power plants are operated at a power factor between 90 and 100 per cent, depending on the load.

Each of the aforementioned synchronous motor-generator sets has a Tirrill voltage regulator connected in its field circuit, which causes to be supplied by the synchronous motors such leading or lagging current as will maintain a constant voltage on the alternating-current busbars from which the commercial and residence lighting is supplied. With proper attention paid to the weight of the revolving elements of the generators in the water-power plants so as to keep within desired limits the speed variations due to fluctuations in the load and with the magnetic circuit of the generators being proportioned to respond within limits to changes in excitation set up by Tirrill regulator in the fields of the synchronous motors, the voltage regulation on the entire system under normal operating conditions is kept within two per cent variation each way from normal.

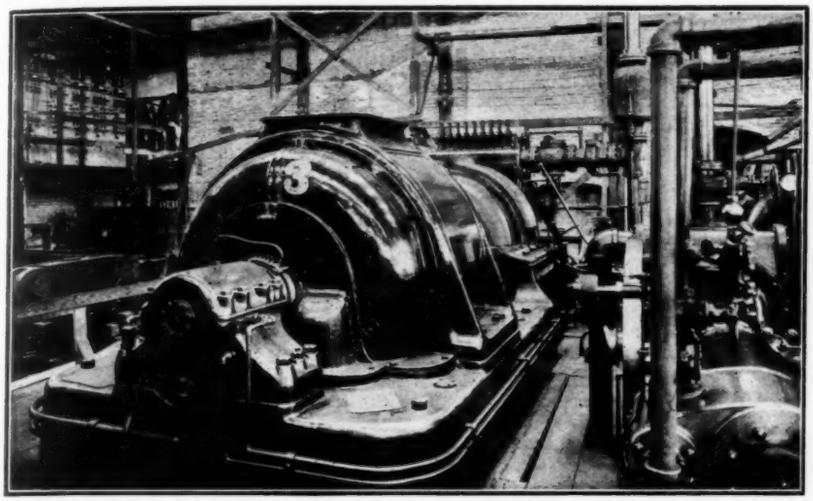
The Indiana & Michigan Electric Company was among the first of the hydraulic companies to supply mixed service from the same sets of transmission lines, and has been very successful in working out the regulation problem. Two or three interurban substations are as a rule connected between the water-power plants and the step-down substations for lighting, yet by regulating the terminal voltage with synchronous motor-generator railway sets at the points where most of the lighting is done very close voltage regulation is secured, as shown by the accompanying chart taken at about the central point of the system with all

SOUTH BEND STATION—HIGH-TENSION STRUCTURE IN FRONT OF ADJOINING SUBSTATION TO BE REMOVED.



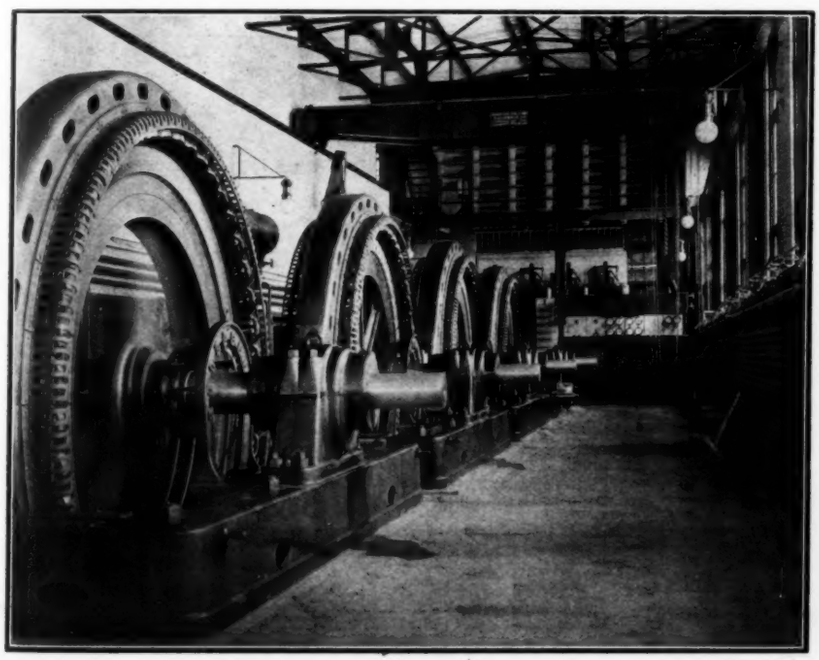
GENERAL VIEW OF BOILER ROOM.

railway substations in operation and the water-power plants being respectively seven miles, fourteen miles, sixteen miles and twenty miles from the point at which the voltage chart was taken.



ONE OF THE NEW TURBO-GENERATORS—CONDENSER SHOWN ON RIGHT.

The South Bend steam plant was a typical old-time steam-operated electric-light station, with three engines driving a long line shaft, to which a number of generators for arc lighting, incandescent lighting and direct-current service were belted. Each generator belt ran over a clutch pulley on the line shaft and could be started and stopped by throwing in and out the proper clutches. This plant later coming under control of the companies owning the hydraulic plants, made it necessary to rebuild the steam plant to get suitable operating characteristics from it for parallel operation with the water-power plants, and changes have been made in the machinery from time to time as was made necessary by increase in the water-power plants until within the last year it became necessary to rebuild the building in order to accommodate further additions and changes in the steam-plant equipment. During the spring, summer and fall of 1910, the changes in the building were made. It was necessary during the summer and fall of 1910 to keep the steam plant either in continuous operation or ready at any time to place it in operation. Consequently the building of the new structure on the same location occupied by the old steam plant and keeping the apparatus in the old building in operation made the rearrangements of apparatus in the old building and the erection of the new building a rather complicated and difficult problem.



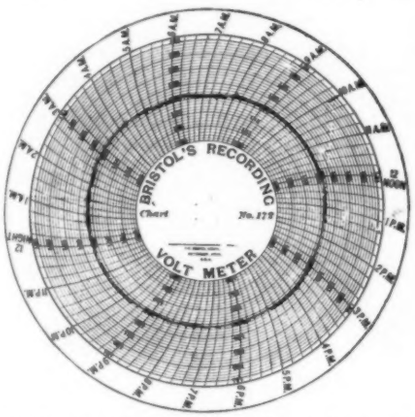
INTERIOR OF TWIN BRANCH HYDROELECTRIC PLANT—ONE OF THE PLANTS SUPPLYING SOUTH BEND.

The steel for the new building was designed with the field riveting to be done being left in such a way as to make it possible to erect part of the steel inside of the old building, such parts projecting through the roof of the old building and the additional parts being set up and riveted in place outside of the old building. After the new skeleton steel work was erected the old roof was supported temporarily from same and some temporary false walls constructed on the skeleton steel work beneath the old power-house roof and inside the old power-house walls. The old power-house walls were then torn down and the new foundations, walls and roof were then built around and over the old power-house roof and temporary walls, this arrangement making it possible to build the new power house entirely from the outside and at the completion of the building operations, leaving a power house within a power house. The work of tearing out the old roof and temporary walls from within the new building has just been completed and the erection of the inside steel work for switchboard, operating galleries, etc., is now under way, and after completion of this stage of the work the switchboards will be moved up on the operating galleries, from which galleries the operator has a point of vantage from which he can see the entire operating equipment, consisting of steam turbines, motor-generator sets and all the necessary auxiliaries and accessories, and the placing of the switchboards on the galleries will give additional floor space for the rearrangement to better advantage of the different auxiliary units. The fact that the steam plant is an auxiliary and is to be operated in parallel with the water-power plants has had a decided bearing on the general arrangement and design of the steam plant.

General views of the interiors of both

the boiler and generating sections of the South Bend plant are shown in the accompanying illustrations. The boiler equipment comprises ten 400-horse-power Wickes vertical-type boilers. They are arranged in a single row in batteries of two boilers each. A steel smoke stack is provided for each battery, these stacks being 130 feet high and six feet in diameter. The furnaces have fifty-six square feet of grate surface and with a poor grade of Indiana coal a boiler efficiency of sixty-two per cent is obtained. In the bunkers, shown over each of the boilers, there is stored sufficient coal for thirty-six hours' run, which coal is down-spouted into the stoker hoppers, engine-driven mechanical stokers being used throughout.

The arrangement of apparatus in the boiler room makes it possible to get the steam plant in operation with a minimum number of boiler-room attendants in case of an emergency. The boiler-feed water valves, feed-water pumps, stoker engines and feed-water heater accessories are centrally located so as to be under supervision of one man, who, by standing in an arched doorway between the boiler room and the engine room, is at all times in such position as to view the operation of the steam turbines and auxiliaries and the aforementioned boiler-room auxiliaries. By suitable governor adjustments of the steam turbines, the problem of the proportionate division of load between the steam plant and the water-power plants when operating in parallel and subject to load fluctuations has been successfully solved. Overhead ground wires are now being installed on the transmission lines for the better protection of the lines against lightning and resultant troubles.



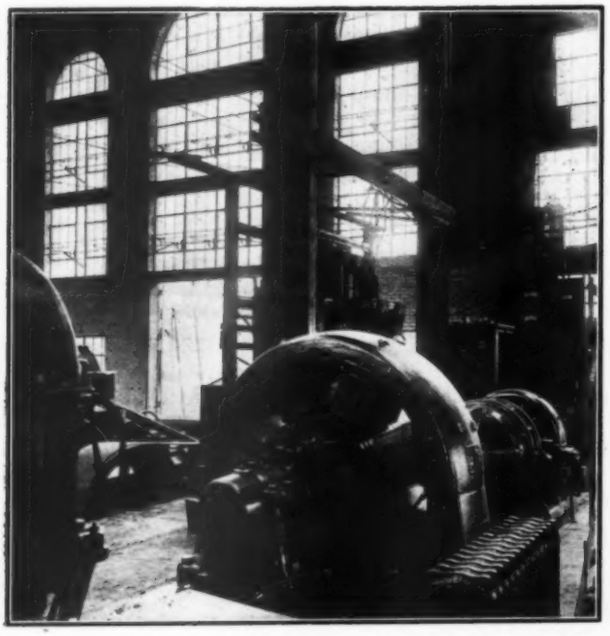
VOLTAGE CHART READINGS TAKEN AT CENTER OF SYSTEM.

The generating equipment of the South Bend plant comprises, at present, one 1,500-kilowatt Westinghouse turbo-generator and one 2,000-kilowatt General Electric turbo-generator. As soon as the last of the old engines can be removed an additional unit of 2,000 kilowatts capacity will be installed. The generators are wound for 2,300 volts, three-phase, sixty-cycle alternating current. The smaller unit is excited by a direct-connected 27.5-kilowatt direct-current exciter. The excitation current for the larger unit is taken from a sixty-kilowatt motor-generator set which also supplies excitation for the railway motor-generator sets.

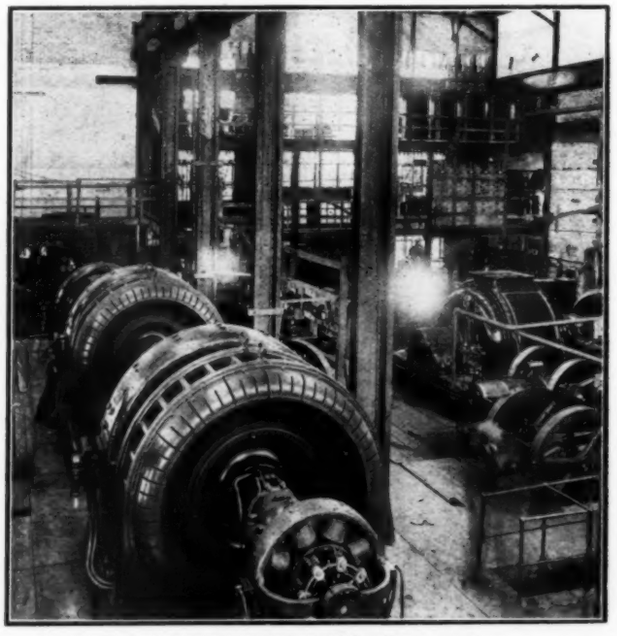
As may be seen from the accompanying general view, a row of three motor-generator sets is placed along the south wall of the plant. Two of these units are of 750-kilowatts capacity and one of 500-kilowatts capacity. In the same line with these sets are placed a 300-kilowatt rotary converter and the sixty-kilowatt exciter set.

The location of the various other apparatus has not yet been decided upon. As the old apparatus is taken out the new machinery is located in the most suitable location consistent with the general plans of the engineers.

The engineering features of this entire reconstruction, as well as of the various hydroelectric plants mentioned, were planned and superintended by L. E. Andrus, general superintendent of the company.



VIEW OF ROTARY CONVERTER (IN FOREGROUND) AND EXCITER SET.



RAILWAY MOTOR-GENERATOR SETS.

Interstate Wireless Act.

A bill has been passed by the United States Senate, prohibiting the transmission between States, of telegraph and telephone messages of certain kinds. The bill is intended specifically to prevent the transmission of messages offering to enter into a contract for speculation in cotton.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

MID-YEAR CONVENTION.

The report of the first three sessions of the mid-year convention of the American Institute of Electrical Engineers held in Schenectady, N. Y., and Pittsfield, Mass., appeared in our last issue.

The final session was called to order by President Jackson, at Schenectady, on Thursday morning and the paper by E. B. Merriam entitled "Oil-Break Circuit-Breakers" was presented by the author.

OIL CIRCUIT-BREAKERS.

The author discusses the application, characteristics of operation and refinements of design which make it possible for this type of circuit-breaker to interrupt circuits carrying large amounts of energy without producing objectionable disturbances on the line. Air-brake circuit-breakers, owing to the large vicious arcs which they produce, are unsuited for general alternating-current circuit-breaking purposes. While the duties of an oil circuit-breaker are to connect, disconnect and isolate different parts of an electrical system, its most important function is to relieve the system of dangerous overloads or short-circuits which would otherwise prove disastrous to the service. A distinctive feature of the oil circuit-breaker lies in the fact that when the alternating current which is maintaining an arc in oil passes through zero, the current is interrupted and remains so until the voltage rises to a sufficient value to puncture the insulating film of oil which has had time to flow in between the contacts. A description is given of the auxiliary devices which render the oil switch selective in action and the conditions are stated under which it is advisable to use a non-automatic switch and when an automatic or a time-relay one should be used. Since the efficiency of an oil circuit-breaker depends, to a great extent, upon the quality and the condition of the oil, it is necessary to inspect regularly. Flash and burning points should be as high as possible, and its dielectric strength not less than 40,000 volts between half-inch disks placed 0.2 inch apart. The rupturing capacity of an oil circuit-breaker depends upon the velocity with which the contacts part, the electrical characteristics of the circuit, the quality of oil used, the number and direction of the breaks, the magnitude of the current, etc. If the contacts move apart slowly the arc formed has time to become very violent and destructive. If the power-factor is less than unity, the voltage is not in phase with the current and this makes it more difficult to quench the arc. In order to limit the amount of energy which may be concentrated at any fault, the present tendency is to design generators with large internal impedance, permitting the use of circuit-breakers on systems of larger capacity than heretofore.

B. G. Jamieson, in a written discussion of this paper, said that if it were possible to design a circuit-breaker which would instantly remove a member of the system as soon as it became faulty, without injury to the system, the results would be ideal. He said that the outline of the basic principles upon which the breakers described in the paper are designed, indicates that the development has been along entirely different lines.

E. M. Hewlett said that on a large generator capacity the switch must be designed to take care of whatever the busbar will give it. If it is necessary to open the circuit instantaneously on very large power systems this can be done by making the switch large enough to do the work, but when economy of design in the station is required, when everything must be considered to make the least cost a time limit should be put in, also perhaps reactance and everything that can reduce the work required of the switch.

L. C. Nicholson said that his experience has been that it is not good for the life of a switch to operate too many times in succession within short periods. The only explanation is the carbonization of the oil, the oil not having sufficient time to settle, as the carbon particles in the oil are too close to the contact to make the oil effective. He said it is not necessary to change the oil if it is allowed to settle for a day. The carbon settles to the bottom of the tank, and the oil is all right for the time of the next trouble. Another point brought up was that instantaneous setting of the circuit-breaker is very bad for it, and it is practically impossible to open the circuit-breaker in less than two-fifths of a second.

W. L. R. Emmet spoke of the size of the circuit-breakers in use today and said they should not be made larger but that further avoidance of trouble should be accomplished by limiting the amount of current likely to go through any circuit, by the use of reactances and other means. He said it is hard to realize the extent and violence of some of the short circuit which have happened in different parts of the country. A number of prominent cases was cited.

J. C. Barrows referred to the discussion of Wednesday on the subject of placing reactances in busbars and in generator leads, in order to limit the stresses on the generator and also the tax on the oil switch. He said that it would seem, on looking into the oil-switch phase of the matter, that putting a reactive coil in the circuit will increase the tax on the switch. Considering the time-current characteristic of the short circuit he said that it should also seem if an oil switch is called on to rupture the circuit before the current settles down to its final value the tax on the switch will be more than in proportion to the excess, because during the drop of short-circuit current the armature is reacting on the field, tending to kill the field, and if the switch opens before the field is killed, the actual energy in the circuit available to maintain the arc would be much higher and so the tax on the switch would be much greater than the current would indicate.

H. W. Cheney in a written discussion said it is possible in a well-designed circuit-breaker to interrupt the circuit abruptly at the zero point of the current wave without successive re-establishing of the current flow by means of rapidly moving multiple-break contacts, especially on circuits of medium potentials. Mr. Cheney submitted in support of this statement some oscillograms made during recent tests on a 200-ampere circuit-breaker. The circuit-breaker which was under test at the time these records were made is provided with auxiliary arcing contacts which remain in contact until the moving element of the switch has attained considerable velocity. The moving element of the switch is comparatively light in weight and is spring-accelerated at the point of contact separation so that a very quick break was obtained.

W. H. Powell, referring to the tests of Mr. Cheney, said they were made on a circuit-breaker, the load being controlled by a water rheostat, and hence the power-factor was practically unity. The first test was made by gradually bringing up the current to 452 amperes, 2,360 volts, sixty cycles. The load was connected across the line on the low side of the circuit breaker, and the voltage was between the second and third phases, and the current on the first phase.

W. S. Franklin suggested that it be well worth a trial to fill an oil circuit-breaker with a moderately pure distilled water. He said you would get a column of steam at the start, as soon as the steam condensed and the actual arc arose, you have a resistance of 100,000 ohms in circuit, and have a much greater heat capacity, and also have a much more mobile fluid in the circuit-breaker. In regard to quick versus slow opening, Prof. Franklin said

that it is really a question as to where you will handle the short-circuit energy. Are you going to handle it in the oil switch itself, or take care of it in some auxiliary device which is installed for that purpose? Another question brought up by Prof. Franklin was the insertion of a condenser in parallel with the circuit-breaker.

C. F. Scott spoke of the responsibility of the designer which is to recognize what these conditions are, to properly adopt the different parts of the apparatus, so as to give the best practical operation under the conditions which will exist; in the second place to make his circuit-breakers and transformers, for example, of such performance characteristics that they will do duty in that plant, not necessarily in some other plant or some ultimate plant; and then certainly he must understand the kind of conditions we have been considering here so that he can foresee and determine what the proper relation and strength of the different parts of the apparatus shall be before they are installed, instead of after the trouble has occurred.

C. P. Steinmetz said the problem of the oil switch has always been and still is that of quick opening versus slow opening. If we can hold the contact closed until the generator field has gone down to its short-circuit value, and the momentary short-circuit died down, then we get the safest condition for the oil switch, but we do not put an oil switch in a system for the purpose of having the oil switch saved, but to save the system, and the reason we have the switch is to protect the system from destruction by these enormous short-circuit currents. That means that we must open the switch as quickly as we must open the switch as quickly as possible to save the system. Where the short-circuit current is limited by a long transmission line, so that its value can never be disastrous, then it is safe to hold on, but not otherwise.

H. L. Smith said that one point which has been quite largely dwelt upon in connection with the rupturing capacity, which after all is one of the most important factors of the switch, is the question of power factor. In different sizes of stations it is possible to get different effects on the oil switches due to the variation of power factor—that is, it is conceivable that some of the smaller stations may give worse conditions than a station of fifty per cent larger capacity, and that, of course, induces a variation that has to be considered in the selection of switches. The question of rating these switches has in the past been based almost entirely on the results of numerous tests, and presumably these tests have been made at relatively low power factors, consequently it shows that they are in the right line.

W. S. Franklin said that very few electrical engineers realize that there is a limit to the shortness of opening of the circuit, by which no increase of voltage is created, by making the opening shorter. If the circuit is opened in an infinitely short time you do not get a uniformly high voltage; that is, you are likely to be mistaken in thinking of the old, simple circuit conditions that you thought of in your elementary days.

After brief remarks by E. W. Rice on the reliability of service the president called on Mr. Merriam to close the discussion. It was agreed that the questions asked of the author be replied to by written communications.

The next paper presented was entitled "Proposed Application of Electric Ship Propulsion," and was read by the author, W. L. R. Emmet.

ELECTRIC SHIP PROPULSION.

This paper describes some of the newest designs which have been prepared for ship propulsion by electricity and gives detailed information as to their various features. The most important reason for the adoption of electricity is that of speed reduction, the ship turbine being very large, complicated and expensive, and relatively inefficient, while the high-speed machine is very simple in construction, small and highly efficient.

In all vessels quick stopping and reversal is of great practical value and this quality is particularly valuable in warships. The effectiveness of reversal is dependent both upon the area of propeller blades and upon the torque available for reversal of propellers, so that the requirements of reversal afford an additional reason for desiring low propeller speed, the area of low-speed propellers being larger, the tendency to slip is diminished.

Since practical propeller speeds are always much slower than desirable for turbines, the tendency is to operate marine turbines at speeds below their best point of performance and consequently their efficiency falls off very rapidly with further diminutions of speed. In an electrically propelled ship an excess speed condition can be adopted for the maximum revolutions so that the loss of efficiency with diminishing speeds is relatively less. One of the important advantages of electric propulsion as compared with other possible methods of speed reduction lies in the fact that arrangements can be made by which the ratio of the reduction is changeable so that the turbine may be run at its most effective speed under more than one condition of the vessel's operation.

In this paper some specific information is given concerning two cases of electric propulsion designs. One of these relates to the apparatus covered by a proposition recently made to the Government for propelling machinery for Battleship No. 35 and other applies to the machinery covered by propositions recently submitted to shipbuilders for propelling machinery to be used in one of the Government's colliers.

The first of these cases being that of a high-speed warship, the arrangement has been made such that two ratios of speed reduction could be used, the change from one to the other being accomplished by changes of connection which accomplish a change in the number of poles of the propelling motor. In the second case no such pole changing is used, the ratio between turbine and propeller being fixed at all speeds.

In the battleship, two generating uits and four motors are used so that an additional gain in economy can be effected at all speeds by operating with one-half of the apparatus in use. In the case of the collier, however, the speed conditions are very favorable to the turbine and the speed efficiency curve is extremely flat as compared with that of turbines generally used for direct propulsion of ships.

The discussion was opened by C. P. Steinmetz, who said that electric ship propulsion promises to be one of the most important material advances in modern marine work, and more particularly in the highest product of modern naval engineering, the battleship. In the propelling machinery of the ship, the condition which is foremost is to secure the highest possible weight and space economy, and the power economy is of importance only in relation as it determines the weight and space economy, especially in military vessels. Any decrease of the weight and space of the propelling machinery means more space for coal, and increase in the efficiency of the propelling machinery means more distance traveled, or higher speed, on the same amount of coal. Of all the prime movers available in ship propulsion, the most efficient one is the steam turbine. It is essentially a constant-speed motor, analogous to the shunt motor. However, a constant-speed machine, such as the turbine, is not suited to operating at comparative speeds with equal efficiency, and at the highest efficiency, but an electric motor can do that. We can have an electric motor operating with equal efficiency at two or more speeds, and therein lies one of its advantages.

Gano Dunn spoke of the great adaptability of electrical connections. He said that it is not so much the efficiency or any other characteristic of electrical application, that leads to its introduction, but it is because we can do

things with electrical methods that we cannot do otherwise.

Maxwell Day said there are three small ships in Europe driven by internal-combustion engines and electric motors, part of them arranged with magnetic clutches, so that all the manouvering and reversing can be done by the motors operating on the Leonard systems, and when the vessel is under way at full speed, the motors are overloaded to bring the engines up to propellor speed, and the magnetic clutch thrown in, and the fields disconnected electrically. The Chicago fireboats are also equipped with turbine-driven generators and alternating motors, also operating on the Leonard system. The control of these boats is so perfect that they can be taken through a crowded river and stopped for drawbridges and turn sharp corners, without using the rudder, if necessary.

W. B. Potter spoke of the method of drive which is being applied to electric cars, which carries out in its fundamental principle the same ideas which Mr. Emmet is applying to the propulsion of ships.

Following this discussion, President Jackson referred to the action of the Board of Directors, proposing the appointment of Secretary Pope as Life Honorary Secretary of the Institute and spoke of the forthcoming ballot on this subject.

The next paper, entitled, "Voltage Regulation of Generators," was then presented by H. A. Laycock, the author.

VOLTAGE REGULATION OF GENERATORS.

Mr. Laycock's paper is devoted principally to voltage regulation of alternators. This was formerly accomplished by composite field windings. Most automatic regulators have been of the automatic rheostat type, but this is usually too sluggish. To obtain good regulation the inherent regulation of the generator must be good and the exciter must not be run at too high magnetic density. The author devotes much space to description of the latest types of Tirrell regulators and their action. These adjust the exciter field and thereby maintain either constant or what is equivalent to overcompounded busbar voltage. It is possible to use such a regulator on a rotary condenser for maintaining the power factor and voltage on long transmission lines. A number of typical installations are described. Regulators for direct-current generators are also discussed. A special form of regulator was described for use in hydroelectric generating plants. In case of short-circuit the regulator would tend to raise the exciter and generator voltage to abnormal values. To prevent this, overload and high-voltage relays are placed in the transmission lines and set so that in abnormal conditions the connection to the regulator is broken until the voltage is reduced to normal again.

H. G. Reist said that the use of regulators on generators allows generators to be built with poorer regulation than has been thought desirable in the past. This poor regulation is a matter that is assuming considerable importance lately. He said that anything that could be done towards reducing the flow of the currents at short-circuits is of great advantage, and this may be accomplished by building machines of poorer regulation and then in turn providing regulators.

Carl J. Fechheimer said that it is becoming the opinion more and more that poor regulation is really desirable in a great many cases rather than too close regulation. This applies especially in case of high-speed generators, particularly those of the turbo type, in which the size of the machine is almost entirely determined by the rotors, than by the stators—in fact, it applies to all turbo-generators, and other high-speed machine generators, which are to operate on circuits in which induction motors are used, circuits having rather low power factor.

E. J. Berg and W. S. Franklin then presented "Briefs on Vector Rotation."

THE DIRECTION OF ROTATION IN VECTOR DIAGRAMS.

Of the several methods of representing alternating currents and voltages graphically, there are only two which are simple enough to consider: (1) A rectangular system of co-ordinates with time as abscissas and instantaneous values as ordinates. (2) The polar co-ordinate system, where time is represented by the angle and the instantaneous values by the radius vector. For a sine wave the polar curve is a circle. Examples were given to show the simplicity of the latter method and the advantage that it could be used equally well for all cases whether the quantity varied harmonically or is distorted by components of higher frequencies. The polar system has also the advantage in getting effective values, since the square of the effective value is obtained directly from the area of the polar diagram. He had found this method most suitable to give students clear ideas. While the crank diagram is suitable enough for simple cases with sine waves, it does not lend itself well to actual practical cases. The writer, therefore, advocates the use of the polar diagram in preference to the crank diagram.

An abstract of Professor Franklin's paper follows.

CONVENTIONS IN CLOCK DIAGRAM REPRESENTATION.

The author considered two styles of diagrams designated as A and B, and pointed out the relation of these to the geometrical conventions in trigonometry and the interpretations of complex quantities in algebra. In method A a harmonic quantity is represented by the projection of a line upon one of two rectangle axes, one representing the sine of the time angle and the other the cosine. In this system a lagging current is behind its electromotive force with respect to the direction in which angles are measured. Two vectors in this system are added after the manner of the parallelogram of forces.

In method B polar co-ordinates are used and positive angles are measured in the same direction as before. In this system the instantaneous value of a quantity is determined by the intercept of the radius vector upon the polar diagram. It can also be regarded as a projection upon the radius vector of a fixed line, which may be regarded as the vector representation of a current or an electromotive force. A lagging current in this case is presented by a vector which is ahead of that representing the voltage. The addition of two vectors gives the same practical result as before, since the portions of the radius vector cut off by two given circles are equal to the portion cut off by a third circle, whose diameter is obtained by the addition of the two diameters, according to the parallelogram of forces. The author considers the idea of projection the most important in vector representation and consequently favors method A. While nominally method B uses a positve method of rotation, it is in a relative sense using the negative direction.

This paper was discussed briefly by G. L. Hoxie and Prof. C. A. Adams. Mr. Hoxie said that it has been his experience in teaching alternating currents that some students will pick up an idea in one way and some in another, and that the teacher should present the same matter from as many angles as possible, and with almost endless repetitions. It would seem that the majority of students find that rectangular co-ordinate system most readily grasped. The teacher must dwell a long time on instantaneous variations, and the student gets his first clear understanding from the rectangular and polar systems described in the paper. The notion of vectors, the idea of projection, and the complex quantity, should be explained. The analytical and graphical conventions of the complex quantity should be learned, and the effective values of currents and electromotive forces (considered thereafter rather arbitrarily as directed quantities) should then mainly be dealt with.

C. A. Adams said that it is claimed for the co-ordinate representation of the alternate curves in vectors, that it has the advantage that they enable one to obtain the R. & S. value by your number. He said that it seems that outside of the question of the actual vector representation itself, that is practically the only argument in favor of the polar-co-ordinate curve.

Following this discussion, a resolution was read expressing gratification at the enterprise of the Pittsfield and Schenectady Sections. The meeting then adjourned.

ELECTROLYTIC CORROSION OF IRON IN CONCRETE.

DISCUSSION BEFORE JOINT ELECTRICAL MEETING IN CHICAGO.

A joint meeting of the Chicago Section of the American Institute of Electrical Engineers and of the Electrical Section of the Western Society of Engineers was held in the Society's rooms, Monadnock Block, Chicago, on the evening of February 22. Prof. Charles F. Burgess, of the University of Wisconsin, presented a paper on "Electrolytic Corrosion of Iron in Concrete."

Professor Burgess referred to the earlier investigations on this subject, particularly that of Knudson as described in an American Institute paper in 1907. The results of some of these investigations indicated not only corrosion of the iron, but also disintegration of the concrete. Professor Burgess urged caution in accepting such results because they have not been verified by later investigations.

The subject is one of great importance because it affects the life and stability of all iron structures imbedded in concrete and of reinforced concrete that may be subjected to stray electric currents. It was formerly believed that burying iron in concrete protected it not only from ordinary rusting, but also from the action of electrolysis. The latter is not true, unless the concrete is waterproof or impervious to moisture. Ordinary concrete has many cavities or voids through which it absorbs water and other solutions from the soil and thereby becomes more or less conducting. The resistance of a foot cube of concrete varies from thirty ohms to several thousand ohms, depending on the composition of the concrete, its density, the amount and strength of the solution it holds, etc.

An investigation of the subject was undertaken at the laboratories of the University of Wisconsin under the direction of Professor Burgess. Two series of tests were made; in each case about ten two-inch iron pipes were imbedded in concrete blocks having various grades of cement and various mixes from neat cement to relatively high sand and gravel bearing concrete. In the first set of tests the blocks were set in jars containing ordinary lake water and an electrode; eight volts constant pressure was impressed between the pipes and electrodes steadily for 180 days; the current and polarization pressure in each jar was measured from time to time. At the end of the tests the corrosion was found to be slight; the loss of weight of the iron varied from 1.2 to 11.7 grams in the different samples. In the second set of tests the cement and concrete blocks were of slightly smaller diameter and there was used a three-per-cent salt solution in which they were immersed. The current was also applied at eight volts continuously for sixty-four days and similar readings were taken. A great deal of corrosion was observed on the pipes when the blocks were broken open, many of the samples having larger or smaller holes; the loss of weight of the iron was 105 to 247 grams. On the outside of the latter blocks there were large formations of ferric hydrate crystals. With the salt solutions the current efficiencies varied from forty to eighty per cent; the polarization voltages were also higher than with lake water.

The results indicated that at eight volts constant potential one might expect the following corrosions per square foot of exposed iron surface: with ordinary water, from 0.0036 to 0.082 pound; with salt water, from 2.7 to 5.85 pounds. This shows the great increase that salt or similar solutions produce in the corrodibility of iron from electric currents. In some of the samples there were noticed fine cracks in the concrete about the pipe; these might have been produced by causes other than the current. At any rate, there was no perceptible deterioration or disintegration of the concrete, contrary to some of the previous findings.

Professor Burgess concluded that the results were not finally conclusive and further investigations were desirable. So far little damage has been noticed in practice that could be directly traced to electrolytic corrosion of iron in concrete. This may be due to the relatively short time which this construction has been used and subjected to electrolytic action. One case had come to his notice of a failure due to this cause near an electric railway power house. Aside from preventing heavy stray currents, several ways seemed to suggest themselves of preventing damage to iron in concrete, among these being waterproofing of the concrete, first covering the iron with a coating of neat cement, and breaking up the electrical continuity of the iron structure.

The discussion of Professor Burgess' paper consisted principally of a series of questions to which the author replied. Among those who made brief remarks were Chairman J. G. Wray, W. B. Jackson, R. F. Schuchardt, J. N. Pierce, C. A. Keller, W. C. Bauer, G. T. Seely, O. E. Strehlow, W. H. Finley, R. H. Rice, F. F. Fowle, and L. J. Hotchkiss.

Professor Burgess closed the discussion by stating that the kind of iron does not materially affect its electrolytic corrosion. The porosity of the concrete has a marked effect. The greatest corrosion was noticed at the top of the concrete blocks, a few inches above the level of the solution, which of course worked its way up by capillarity; the action of the air doubtless aided at this point. Where objection has been made to the use of cinder concrete, it is because any particles of carbon in the cinder would tend to form a local couple with the iron; any corrosion from this cause would probably be slight as the polarization would limit it; a coating of neat cement surely would prevent it. If the iron is rusted first subsequent corrosion is not so marked; this has been, in fact, recommended by some in order to increase the bond between iron and concrete in reinforced concrete.

Japanese Exposition in 1917.

An international exposition is to be held in Tokyo in 1917. Hirayama Seishin, a member of the upper house of the Japanese Parliament, has been chosen president of the exposition. He has already had considerable experience in connection with other international expositions, having served on the Japanese commissions of 1900 at Paris, 1904 at St. Louis, and 1911 at Turin.

New York Proposal to License Engineers.

In view of the bills which have been introduced in the New York Legislature requiring examination and license of engineers undertaking work in that state, the American Institute of Electrical Engineers appointed a committee to investigate and report upon the matter. The report of the committee is as follows:

WHEREAS, there are now pending in the Legislature of the State of New York three proposed Acts restricting the professional activities of the members of the American Institute of Electrical Engineers and limiting the freedom which they have always heretofore enjoyed in the practice of their profession and under which they have accomplished so much for the public welfare, and

WHEREAS, the passage of these bills would have a deadening effect upon the profession of electrical engineering in the State of New York and would prevent the healthy growth and development of the practical applications of electricity,

IT WAS RESOLVED by the Board of Directors of the American Institute of Electrical Engineers that a special committee of the Institute be appointed to exhaustively investigate the subject matter of these proposed Acts, to confer with other professional and learned societies, and to take such action regarding the proposed legislation as might be necessary to safeguard the future of electrical engineering in the State of New York.

Pursuant to this resolution of the Board, the special committee has carefully investigated the subject, has conferred with eminent engineers and educators and with members and officials of numerous engineering societies of the highest standing. This committee has found that it is the unanimous opinion of all with whom they have consulted on the subject and it is their own unanimous opinion, after full investigation, that the passage of any or all of these bills is against the best welfare of the people of the State of New York, that they do not represent any substantial public demand or need, and that their passage would be an undue interference with the liberties of electrical engineers in the State of New York. The committee also finds that these proposed Acts would restrict the liberties and impose harsh and unnecessary restrictions upon the members of all of the other branches of the engineering profession.

Your committee therefore recommends to the American Institute of Electrical Engineers that in the interests of electrical engineering, in the interests of its members, in the interests of the clients of engineers and in the interests of the public generally, suitable representations be made to the Legislature of the State of New York and that every practicable means be adopted to dissuade that body from permitting these proposed Acts to become laws, and that the American Institute of Electrical Engineers, through its president and other officers and members, join in protesting against the passage of these Acts with the representatives of other engineering societies at such hearing or hearings before the Legislature of the State of New York as may take place in regard thereto.

Brooklyn Edison Company Dines Electrical Contractors.

The annual dinner to the electrical contractors of Brooklyn, N. Y., was given by the Edison Electric Illuminating Company, of that borough, at the Montauk Club, Saturday evening, February 25. There were about 200 in attendance, and it was a very successful and agreeable affair. The dinner was presided over by T. I. Jones, general sales agent of the Edison Company. The dinner was enlivened by an orchestra and by songs which were distributed to all the guests in the form of a handsome booklet containing the menu and list of speakers. The occasion was thoroughly enjoyable, and the *esprit de corps* existing between the contractors and the representatives of the Illuminating Company was very evident. As the presiding officer said, the percentage of harmony was evidently 99.9 per cent. The slogan was "Brighter Brooklyn," and the close and friendly relations existing between the contractors and the company were highly commended on all sides.

Photo by J. G. Waters

PARTIAL VIEW OF BANQUET TO BROOKLYN ELECTRICAL CONTRACTORS.

Mr. Jones stated that the number of contracts made during 1910 was double the number closed in 1909, and that the present year had started with prospects of even greater results. This he attributed to the co-operation that existed.

W. W. Freeman, vice-president and general manager of the Edison Company, who is also president of the National Electric Light Association, in an interesting and practical talk called attention to the fact that there were probably 50,000 houses in Brooklyn that had been constructed before the era of wiring houses for electric lighting at time of erection had prevailed, and it was time now to have these houses wired; for electricity was no longer a luxury, but a convenience and real necessity. He stated that if these 50,000 houses were wired, at an average cost of $150, it would amount to $7,500,000, of which the contractors would probably receive $5,500,000, and the lighting company the balance. Mr. Freeman's remarks were greeted with much applause and pleased anticipation on the part of his audience, who announced enthusiastically, in response to an inquiry: "Freeman is all right."

Other speakers were E. J. H. Thiemer, president of the Kilowatt Club, who spoke for "The Contractor"; J. C. Forsythe, chief inspector of the New York Board of Fire Underwriters, who spoke very interestingly and instructively on the subject of "The Fire Underwriters"; Charles W. Price, who spoke for "The Technical Press," and Andrew McLean, editor of the Brooklyn *Citizen*, who spoke at some length eloquently and enthusiastically of "The Present and Future of Brooklyn," and of the important part in the growth and modernizing of the city which had been taken by the Edison Company.

The attendance was a very representative one, and, in addition to the speakers, included, among others: P. R. Atkinson, W. F. Wells, F. C. Bates, R. D. Rubright, W. F. Fairbairn, T. F. Attix, T. C. Cooper, H. A. Sinclair, F. D. Sharkey, W. L. Sturgis, George Weiderman, J. Miller, A. O. Miller, Charles A. Soper, J. J. Snyder, George Bischoff, A. E. Green, A. S. Beach, B. C. King and M. S. Seelman.

Electric Control Valve for Dye Vessels.

A new isothermal valve has been invented by Alfred Baldwin, of Keighley, Yorkshire, England, and is now in operation, whereby when the temperature of a thermometer placed in the dye vessel reaches any fixed point it completes an electrical circuit which, by means of an electromagnet, automatically shuts off the steam. By this means the range of temperature can be kept between 205 and 206 degrees Fahrenheit. Since the employment of steam the temperature in a dye vessel has varied from 208 to 210 on the side where the steam was admitted down to 202 on the opposite side; this difference of six to eight degrees possibly accounts for unevenness in dyeing.

By means of this new control valve it is claimed that ninety-five per cent of the damage can be avoided and there would be a saving in steam of fifty per cent in open vessels to eighty-five per cent in closed vessels.

Annual Report of the Commissioner of Patents.

The annual report of the Commissioner of Patents was recently made public; it is devoted to the business and condition of the United States Patent Office during the year 1910. There were received 63,293 applications for patents on inventions, 1,155 for patents on designs, and 181 for reissues of patents, a total therefore of 64,629 applications. There were issued 35,168 patents on inventions, 639 patents on designs, and 123 patents were reissued. There were regisered 4,239 trade-marks, 370 labels, and 120 prints. During the year there expired 22,768 patents. The total receipts of the Patent Office amounted to $2,025,536.69, the total expenditures $2,005,711.94, leaving a surplus of $19,824.75. The total net surplus in the Treasury of the United States to the credit of the Patent Office amounted on December 31, 1910, to $6,998,227.64.

The total number of patents issued by the United States Patent Office since its foundation was 990,134 on December 31, 1910. The present series of numbering was begun July 28, 1836, previous to which time there had been issued only 9,957. The serial number 1,000,000 will be reached within the next six months. The number of patents issued by all foreign countries from the earliest period to December 31, 1910, is about 2,138,091.

Of the United States patents issued during 1910, 32,059 were granted American citizens and 3,719 to citizens of foreign countries. In proportion to population, more patents were issued to citizens of Connecticut, the number being one to every 1,126. The other extreme was reached in South Carolina, only one patent being granted to every 17,620 inhabitants. Of the patents granted to foreigners, 1,083 were issued to Germans, 894 to Englishmen, 534 to Canadians, 315 to Frenchmen.

Commissioner Edward B. Moore states that the work of the examining corps has improved greatly since the increase of salaries. Searches have been more thoroughly and carefully made. Considerable headway has been made in the classification of United Sates patents; about half of the nearly million patents already granted have been classified. Heretofore it has been almost impossible for the examining force to work with any great degree of certainty in making searches during the examination of applications for patents. The complete classification will also give enormous benefit to the inventors and manufacturers of the country and to the ouside public generally to have this great mass of material in as perfect form for use as it is possible to make it. With this work carefully done it would not be necessary for the Commissioner of Patents to ask for an increased force every year, as the work of examination of the applications of inventors would be very much simplified, and such patents as are granted would have a much greater degree of validity attached to them than is possible without these facilities for thorough search.

On May 15, 1911, there will open an international congress at Washington, D. C., of the Union for the Protection of Industrial Property. The meeting of this congress will probably be the most important in the history of the union. Able and experienced delegates, mostly officials of the fifty or more nations, will be appointed, who will discuss and act upon measures to bring about international concessions and agreements in patent and trade-mark laws, thereby harmonizing the laws of various countries, which laws are at the present time widely at variance, so much so, in fact, that it is almost impossible for inventors and manufacturers to do business with any degree of satisfaction in the various countries affected.

The Commissioner expresses his hearty approval to the effort to establish a court of patent appeals. He again urges a new building for the Patent Office, which is badly cramped for room. The Patent Office has been more than self-supporting since its creation. Its gross surplus is now nearly $7,000,000. This sum represents the net earnings of the Patent Office, and it is due to the inventors of this country that the money should be utilized for the purposes of providing suitable facilities for expediting its work. It is necessary that patents for new inventions should be issued with the utmost promptness after the application for patent has been filed, for such inventions form the basis of vast industries, which inure not merely to the profit of the inventor but to the benefit of the manufacturer, the laborer, the trader, the professional man, and the consumer, and to the commercial interests of the country in general.

A British Official's Opinion of Cable Rates.

The British Postmaster General delivered an address on cable rates at the annual dinner of the British International Association of Journalists on January 28, in which he said:

"The present cable rates, so far as they are used by business men, are not unduly high, owing to the rapid growth of the use of code telegraphy. But the case is different in regard to cablegrams in plain language, whether they are social telegrams or press telegrams. The assent of nearly all of the great cable companies throughout the world has been obtained to a reduction of fifty per cent in the charges for plain-language telegrams which are subject to be deferred for a time not exceeding twenty-four hours in any case. The assent of one or two foreign administrations is still to be obtained to that reform. It is not possible at the same time to press the cable companies for a reduction of press rates. That is a reform for the future, and, it is hoped, the not distant future. When the reduction in the charges for uncoded deferred telegrams has been carried through, it is intended to give immediate attention to certain questions as to unduly high rates for press cablegrams. I believe that nothing could do more to promote the facility of international communication, and therfore nothing is more likely to improve the international relations."

Copper Iodide Sensitive to Light.

The electrical conductivity of copper iodide, like that of selenium, is sensitive to light, being increased gradually by exposure. Blue light is much more effective than red. With short exposures, the effect is proportional to the intensity of illumination, but this is not true for long exposures. The effect is greater in specimens having high resistance. High temperature is favorable to the action when the exposure is short.

It has been shown by Cohen and Sinnige that the electromotive force of a standard cell is influenced by pressure and is increased by a higher pressure. In the case of the Weston cell, the change is 6.32 microvolts per atmosphere, and for a Clark cell 12.3. These results were obtained at 25 degrees centigrade.

THE ELECTRICAL PROPERTIES OF SELENIUM AND THEIR PRACTICAL APPLICATIONS.

BY LILAH B. CRUM.

In 1873, Willoughby Smith, who was using a stick of crystalline selenium for a high resistance in connection with some cable testing, found that the electrical conductivity of this stick was very much increased if he allowed the light to fall upon it. This discovery at once aroused great interest, both on account of the new and unexpected nature of the phenomenon, and on account of the possibility it suggested for a new means of measuring light action. Indeed, even now, after thirty-seven years of serious investigation, the workers upon the selenium cell are ever charmed and startled by its unexpectedness, but still thoroughly impressed with the variety of its applications.

Most of the selenium cells are made upon a small slab of insulating material about which two wires are wound in double spiral. Upon one or more faces of the slab, the spaces between the wires are filled with selenium, there crystalized into a light-sensitive form. In the accepted usage of the term, a "selenium cell" is not a cell, inasmuch as the action of light causes only a change of conductivity in the selenium exposed, and not a generation of electro-motive force.

The selenium cells, as we know them, may be divided into two broad classes, —the light-positive and the light-negative, with possibly a mid-class. The cells belonging to the light-positive class increase their conductivity when exposed to light, but just how much and in what general manner varies widely. In what has been called by Ries the normal type of cell, the conductivity after exposure continues to rise, at first rapidly, and then ever more slowly, while on the other hand, the conductivity upon darkening falls off rapidly for a short time, and then more and more slowly approaches the original dark value. The conductivity of such cells when placed in the light never reaches a value more than ten times its value in the dark, requiring perhaps a minute for the first seventy-five per cent of the change to take place. The cells used by Bidwell were of this type, and so also are those made by Ruhmer of Berlin.

There is a second type of light-positive cell whose conductivity upon exposure rises very rapidly up to a maximum and then gradually decreases. This type has a very high sensibility, the maximum of conductivity in the light sometimes being as much as one hundred times that in the dark, and with the use of a fairly intense light it is reached within the first few seconds after exposure. In spite of the fact that these cells have a resistance of several hundred thousand ohms, by virtue of their high sensibility and their quick action, they are of perhaps the most practical service, especially where the time of exposure is short. Giltay, of Delft, Holland, makes the most efficient of these cells procurable.

As an extreme modification of this type, F. C. Brown, of State University of Iowa, has constructed a much more sensitive cell, in which the conductivity in light reaches a value of as much as three hundred times the dark value. Under the action of intense light, the maximum conductivity is reached within a small fraction of a second after exposure. However, these cells are of less practical value generally than those of Giltay, owing to their extremely high resistances, which usually reach several million ohms.

Ries has called attention to a kind of cell made by him, whose action is of the same general nature as the above, with the exception that the sensibility is many times less, while the decrease of conductivity shown after the maximum is reached is very much greater. In several cases cited by him, the conductivity in the light, some thirty seconds after exposure, actually fell below the value of the dark conductivity; upon darkening the cell, it fell still further below, and then gradually rose to the dark value. This "abnormal" type of cell, as he calls it, thus shows a sensitiveness, both light-positive and light-negative.

The true light-negative variety of selenium was first made and recognized by Brown. It was found by him that upon exposure the conductivity of this variety decreased at once, rapidly at first and then more slowly, but showing at no time a decrease of more than fifteen or twenty per cent. He further found that the resistance was very low, ranging from about five hundred down to ten ohms, while one showed an even smaller resistance than that.

The sensibility of the selenium cell seems to be in some manner a function of its resistance, decreasing with it from the millions of ohms of the high sensibility cell, through the hundred thousands and thousands of the Giltay and Ruhmer cells, until it is actually carried over to a negative value when the resistance becomes very low. However, I have recently made a light-negative sample with a resistance close to one hundred thousand ohms.

The change in conductivity is a function of the light intensity. An increase in light intensity causes the change of conductivity in the Ruhmer cell to take place much more rapidly at first and afterwards more slowly. In the Giltay cell, it causes a more rapid rise to the maximum, and a much more marked falling off of conductivity after the maximum has been reached. By exposing a Giltay cell to the action of very intense light, Brown got a falling off so large that when the cell was darkened the conductivity actually decreased below dark value, after which it slowly rose again to the original conductivity before exposure.

The action of the selenium cell under changes in pressure, in temperature, and in voltage is of the same general nature as under changes in light intensity. In the Ruhmer type of cell, an increase in any one of these factors produces at first a very rapid change to greater conductivity, while in the Giltay type, the rapid rise of conductivity is followed by an actual decrease. Various temperature effects have been studied at some length by Louise McDowell and she finds that owing to the extremely high resistance of the selenium at low temperature the percentage of change upon exposure to light is very much increased, though the action takes place much more slowly than at higher temperatures. Radium and Röntgen rays acting upon selenium increase its conductivity.

It is quite probable that the depth to which the selenium is affected by the various agents extends to a considerable distance below the surface. There seems to be evidence that under the influence of light the crystalline structure of the selenium might be affected to a depth of one millimeter. Temperature and probably pressure act throughout the entire mass.

The cause for the behavior, and for the different types of behavior of the

selenium cell is yet undetermined. The strange and unlooked-for phenomenon which was at first only to be wondered at, was a little later attributed by Bidwell to the action of selenides formed at the electrodes, inasmuch as some sulphides so formed had been observed to render sulphur light-sensitive. However, by the use of carbon electrodes which would not be chemically attacked by the selenium, it was found by Pfund, that the light-sensitiveness did not disappear and, therefore, that the action of light brings about changes in the crystalline structure of the selenium itself. Still, we have yet to explain the varieties of changes brought about in the various cells.

Ries, who has done a great deal of work upon the selenium cell, makes the presence of moisture in the cell a controlling factor. Those cells with moisture show a fatigue after reaching a maximum conductivity, and if the moisture is sufficient, the fatigue may become great enough to bring the conductivity in the light below that in the dark, as in his apparently light-negative cells. Those cells without the presence of moisture are of the normal type altogether. The amount of moisture in the cell is largely determined by the temperature to which it is heated, length of time the selenium is held at that temperature, and the rate at which it is cooled.

Brown has a more comprehensive explanation. He assumes, as was noted in a previous issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, that there are three kinds of crystalline selenium, *A*, *B* and *C*. *A* is an non-conductor of electricity, *B* is a very good conductor, and *C* an extremely poor one. Each cell as it rests in the dark is composed of a certain mixture of the three kinds. When the light falls upon the cell, the relative amounts of the three begin to change, *A* changing into *B* at a definite rate, and *B* into *C* at another rate, while on the other hand *C* is going back into *B*, and *B* into *A* at other rates. Since for given conditions of moisture, intensity of light, pressure, difference of potential, etc., he assumes the rates of change to be fixed it is quite evident that the amounts of each of the three kinds present before the light acts will determine the amounts present at each instant after exposure, and thus establish the conductivity-time curve. Changes in pressure, in light intensity, in temperature, in moisture and in internal conditions of all sorts vary the rates of transformation, and hence the amounts of *A*, *B* and *C* when in equilibrium.

So far as has been tested, this theory is in agreement with the experimental facts, and seems to be entirely adequate.

The process of manufacture determines the type of cell which results. The rapidity with which the crystals form, the temperature at which they form, and the rate at which they are cooled after formation, seem to be among the most significant factors. The purity of the selenium, its dryness, its form, whether vitreous or amorphous, all probably need more or less attention. There are two large concerns at present putting out these cells, Ruhmer of Berlin, and Giltay of Delft, Holland. In our own country no one is at work commercially upon them, although the investigation of the means of producing the various types and the putting of them upon the market would doubtless prove a profitable field.

One of the most valuable of the practical uses to which the selenium cell has been put is for the finer measurements in stellar photometry. Joel Stebbins, of the University of Illinois, has recently completed a most remarkable work upon "The Measurement of the Light of Stars with a Selenium Photometer, with an Application to the Variations of Algol." He used a cell of the Giltay type, kept in an ice pack that it might have a constant temperature and that he might have the advantage of the resulting increase in sensibility. He passed the current continuously through his cell, and when it had reached a steady state, he exposed the cell through the telescope to the light of the star for a period of ten seconds. He read the resistance change by the method of the Wheatstone bridge, allowed one minute for the recovery of the cell, and then exposed it again. By exposing to the light of some standard star and making comparisons, he got a curve for the light intensity of Algol, showing the secondary minimum in its cycle of intensity, which has long been sought for by countless observers using other means. He considered his observations accurate to within two per cent. So sensitive was his means that the diffuse light from the sky, especially when there was a moon, made considerable change in the resistance of his cell.

Wulf and Lucas, in 1905, by use of a selenium cell, determined the period of totality of the eclipse of the sun to an accuracy of one-hundredth of a second. They left a Ruhmer cell of thirty thousand ohms exposed to the light of the sun, while a spot of light thrown from the mirror of the galvanometer upon rotating sensitive paper recorded the deflection of the galvanometer needle.

The "light-telephone" is another promising application upon which much work has been done and considerable success achieved.

Korn has used the selenium cell for telephotography, or the reproduction of pictures. He uses but one large cell, and by means of a moving window lets each part of the object be exposed in order, while a similarly moving window, at the receiving station, admits the proper amount of light to the sensitive paper. This plan does not allow for the recovery of the cell, but by using a faint light the error so introduced is slight. In fact, some remarkably good photographs have been transmitted in this way. Since the receiving station need not be near the cell, this application may possibly be made of much service in newspaper and other work.

Since, as we have noted above, pressure produces a change in the conductivity of the selenium cell, it is one of the hopes of the investigators in this particular field that apparatus may soon be designed and put into use, whereby the change in the resistance of the selenium cell may be made to measure impulsive forces. This will be a valuable addition to physical apparatus, as we have nothing at present entirely satisfactory for this purpose.

Perhaps it is carrying the matter too far to predict the construction of apparatus for measuring differences of potential and of temperature, wherein the change of conductivity of a selenium cell is the significant feature, but at any rate, the properties of the selenium cell suggest a long list of possibilities well worth the time and consideration of practical men.

The membership of the National Electric Light Association was increased by 515 during a recent month.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

ELEMENTS OF POWER STATION DESIGN.—XXV.

STORAGE-BATTERY PLANTS.—III.

BY W. B. GUMP.

Externally Regulated Boosters.—The automatic boosters just described depend for their action upon a considerable variation in the generator voltage. The disadvantages of such a method of operation are: first, that the voltage variation on the battery and the motor load is quite considerable, thus giving poor voltage and speed regulation on the latter; second, that the booster field windings necessary to produce the desired effects require a large space and this demands large machines for a given output and therefore increases the cost of the equipment.

In order to overcome these objections, a number of schemes have been devised which use a shunt-wound booster, the field of which is regulated externally so as to produce a charge or discharge by a shunted current depending upon only slight changes in the generator load.

One of the systems used is known as the Entz system, consisting of the usual equipment of generator and battery, the booster being a shunt-wound machine. Fig. 8 shows complete connections. Here C and C_1 are resistances composed of carbon plates. A lever arm L acts to compress or release the pressure, which increases or decreases the resistance accordingly.

Normally the spring at one end of the lever and the electromagnet at the other act together, compressing the carbon piles so that the resistances C and C_1 are equal. One terminal of the shunt field is joined to the upper ends of the carbon piles, while the other end is connected to the middle point of the battery. The two carbon piles are joined in series across the line, so that their normal drop is equal to that of the line. From the fact that the ends of the shunt coil terminate at the center of the battery, and at the center of the carbon resistances, respectively, it becomes evident that when C equals C_1 no current flows through the shunt coil; therefore, the booster voltage is then zero.

An increase in the external load will increase the magnetism in the series coil, producing a downward pull which compresses the carbon plates of C_1 and decreases their resistance, at the same time increasing the resistance of the column C. The effect is a flow of current in the shunt field through half of the battery and through the carbon column C_1. The result is a potential across the booster in a direction which assists in discharging the battery, thus supplying the additional load.

A decrease in the external load has the opposite effect, that is, to release the pressure of the column C_1, increasing the pressure of C, which increases the resistance of the former and diminishes the resistance of C, causing a flow of current through the column of the latter, through the shunt coil, and the opposite half of the battery, the effect of which is to charge the battery, storing up energy to be used for the next overload.

The direct working range of the Entz system is comparatively small, on account of the limited change in pull in the solenoid and the consequent small change in current flow, which is limited by the size of the carbon piles. For this reason the direct application of this system is restricted to small boosters only. In connection with large machines the control takes place through a separate exciter, working in conjunction with the booster.

The Bijur System.—One of the many systems with boosters externally controlled, is that invented by Joseph Bijur. The diagram of connections is shown in Fig. 9, and will be seen to have an arrangement similar to the Entz system. The chief distinction here is the construction of the resistance. R_1 and R_2 are composed of resistance wire from which a series of taps are brought out, their ends terminating in graduated lengths as shown. These ends are made to dip into, or recede from, troughs of mercury M and M_1, the amount of resistance of either side varying with the pull on the solenoid S, which in turn is controlled by the load. The advantage of this arrangement is that very little energy is needed to cut in and out resistance, as compared to the other system.

The design of the lever and movable resistance are such that the pull to secure balancing between the spring and

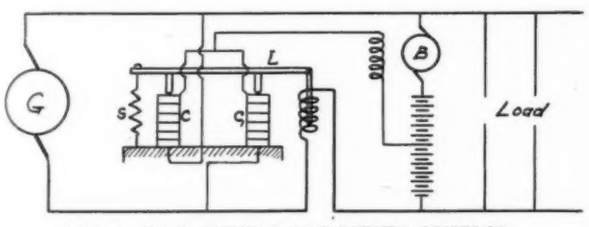


FIG. 8—ENTZ SYSTEM OF BOOSTER CONTROL.

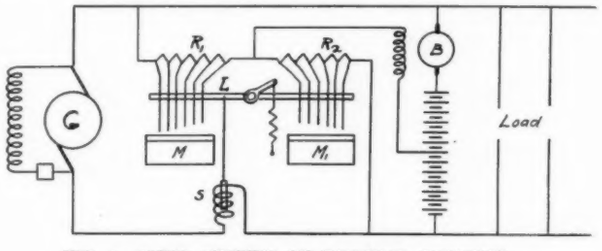


FIG. 9—BIJUR SYSTEM OF BOOSTER CONTROL.

solenoid is constant for all positions, the normal current value of the external load corresponding to a fixed position of the lever. That is, the extent of increased current in the generator required to move the lever away from its horizontal position is not proportional to the load but is a constant. An overload, large or small, will cause the lever to be drawn down on the side of the solenoid, continuing to short-circuit the resistance coils in the mercury, until the shunt field increases the potential sufficiently to discharge the battery. The extent of overload determines the extent of potential rise required by the booster. Therefore, when this potential has been reached by the booster, a further rise will begin to oppose the effect of the solenoid *S*, holding the lever in a position which requires an overload on the generator only sufficient to overcome the friction of the moving parts of the variable resistance. Since this overload is very small, the potential at the generator bus can be maintained constant, while the external circuit can be made to carry overloads having wide fluctuations.

Method of Driving Boosters.—It is customary to drive boosters by means of electric motors, directly connected. Generally this is the most convenient method, on account of having electric power at hand. The case would be unusual in which another form of drive would be used. In a few instances, however, the surrounding conditions might favor the adoption of an engine or turbine. The motor, or other prime mover, must have sufficient output to drive the booster under maximum load conditions. However, in a plain shunt booster used for charging only, the maximum current is at the beginning of charge when the voltage is a minimum; at the end of charge the reverse is true. Therefore, in a case of this kind the motor need have only two-thirds to three-fourths of the nominal rating of the booster.

(*f*) *Design and Construction of Battery Plants.*—Comparatively little data have been published regarding the constructive features of battery installations. This may be due partly to the fact that most battery plants are installed by practically one or two large concerns, in whose hands the layout is generally placed, these concerns furnishing drawings for the complete installation. It is very important that the engineer in charge of the property be posted on the leading features of storage-battery plants, so that the plant may be handled intelligently after it is installed. Otherwise a good many questions may arise in connection with the guarantees of the manufacturer who generally agrees to maintain the battery for a certain fixed sum per annum, upon the condition that the battery is operated according to certain specifications under which it is originally purchased.

It is well to bring out the fact here, that storage-battery engineering is a specialty of the most extensive sort, and

FIG. 10—MOUNTING OF A STATIONARY STORAGE CELL.

at the outset it should be decided that the services of a battery expert be secured who shall give his whole attention to caring for the operation and upkeep of this part of the system. This statement refers particularly to large battery plants, such as those operating in railway and lighting substations.

Every storage-battery installation requires a specially constructed room, or separate building (as the case may be), in which the fumes from the acid may rise, or the electrolyte spill over the cells without destructive effects on any part of the plant. Where the opportunity permits a separate building, it is generally to be advised, on account of its isolation from the rest of the plant. The acid may then be carried to and from the battery room without any likelihood of its spilling upon other apparatus. Furthermore, the facilities for direct transportation of material are almost invariably superior to any other arrangement.

The floor should be covered with a good grade of hard tile brick, which is preferably built on an incline toward the center of each aisle. This affords an opportunity for the acid which drips or is spilled to drain toward the center, where it may be flushed out.

The cells must be supported upon insulators resting upon a timber frame. See Fig. 10. The insulators are of special design, having a flat surface at both ends to insure stability when placed under the tanks.

Railway batteries are almost always made up of lead-lined tanks. Batteries of comparatively small capacity may be contained in glass jars. The chief objection to glass jars is liability to breakage. Their great advantage is that the general condition of a cell may be seen more readily in a glass containing-vessel than in a wood tank. As a general rule, a battery having cells which weigh more than 300 pounds each should be made up of lead-lined tanks, thus avoiding all liability of breakages.

The chief item determining whether the cells shall have a single or a double set of insulators is the voltage employed. For batteries of 125 volts a single set is sufficient. For railway batteries of from 500 to 750 volts, both an upper and lower set, are recommended, since this form of installation is more secure against grounds than with one set. A double setting is shown in Fig. 10.

In planning a battery plant, provision should be made for future growth. For example, suppose that the immediate load calls for a battery having cells of fifteen plates each. It would generally be advisable to provide tanks which will accommodate nineteen or even twenty-three plates. Additional plates may then be added at the end of each element group without inconvenience. Otherwise any desired additional capacity would necessitate a complete set of new tanks, or practically a duplicate battery. It is usually safe to figure on an extension of at least ten per cent. In not a few instances over twenty-five per cent increase is provided for.

The terminal lugs of the plates are joined by lead-burning to the busbar *B*, shown in the figure. The terminals, busbars and all connections are composed of practically pure lead, in order to make them acidproof. The end busbars are constructed with a copper bar imbedded in the lead so as to equalize the potential of the outer plates. In other words, the resistance of the lead busbar is comparatively high, and, on this account, if the middle point of the end bar is connected to one of the outgoing lines, there would be a drop from the middle plate to the ends plates if a low resistance were not provided in the metal joining these plates. This condition does not arise, of course, except at terminals of a row of cells, since all of the other plates are joined in a direct continuous line, the positive plates of one cell being connected to the same bar as the negative plates of cells in series. Fig. 11 shows the plan of a storage-battery room containing 116 cells, of which eight are end cells.

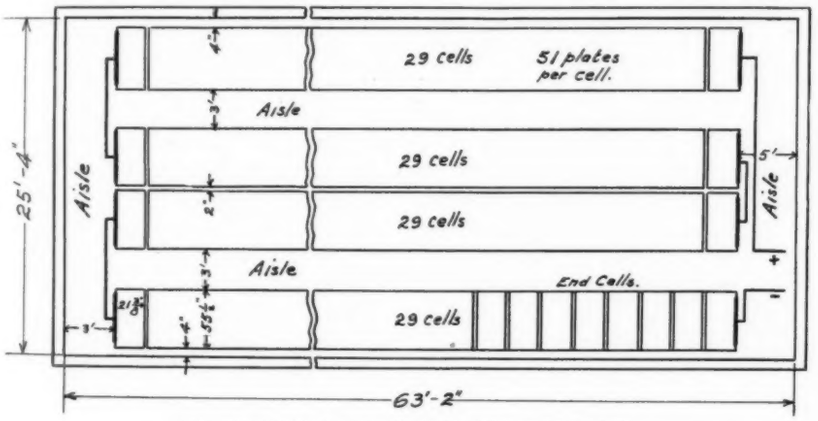


FIG. 11—PLAN OF A TYPICAL BATTERY ROOM.

It is readily seen that all metallic connections within the influence of the fine acid spray or mist, which is thrown out during charge, must be either lead-covered, or provided with some form of acidproof paint. It naturally follows that all installations of end-cell switches, boosters, and battery switchboards must be located outside of the battery room. Otherwise, serious corrosion is inevitable.

The wiring for lighting the battery room should be inclosed in conduit which preferably should be imbedded in the ceiling or walls. Where this is not possible the exposed portions should be made thoroughly acidproof. Wires which extend from the ceiling to lamp sockets should be rubber covered with the best grade of Para rubber insulation. Lamp sockets should be inclosed in porcelain or hard rubber. It is well, after the lamps have been screwed into place, to paint the edges of the exposed copper parts with melted paraffin.

In order to minimize the spraying of the acid with the gases set free in charging it is common practice to cover each cell loosely with a piece of plate glass. These covers must never be sealed to prevent the escape of the gases, which if confined might produce an explosion.

Battery Switchboards. — The usual switchboard equipment for a storage battery is far from complex. At the same time, due judgment should be exercised, both as to design and location, if the battery plant as a whole is to be satisfactory. The switchboard, booster, and all controlling devices, such as end-cell switches, should be installed where the air is dry, and proper ventilation is afforded. As a rule, these adjuncts can be placed in a room adjoining the battery room, provision being made against any possibility of the acid spray or "fumes" reaching this apparatus.

The instruments and switches used comprise:

(1) Voltmeter.
(2) Ammeters.
(3) Overload circuit-breaker.
(4) Underload circuit-breaker.
(5) Rheostats (for charging).
(6) Rheostats (for booster field and motor-starter).
(7) Knife switches.
(8) End-cell switch.

In the case of some small isolated plants, one differential ammeter may be made to take the place of two ammeters. The overload circuit-breaker may also be dispensed with, using a fuse in its place. The latter is not generally to be commended, however.

In large battery plants, such as those used for railway purposes, charging rheostats are eliminated, especially where boosters are employed. Charging rheostats are very convenient in many private lighting installations, but they are not used in connection with regulating batteries.

The object of an underload (or no-load) circuit-breaker is to prevent the battery from reversing during charge and discharging back into the generator or busbars; this would happen if the generator voltage suddenly dropped to below that of the battery. This piece of apparatus is indispensable and should always be included in a battery plant. There may be a few exceptions to this rule, but they are rare, and a safeguard of this nature generally pays for itself in preventing a heavy discharge or complete drain of the battery in an uncharged state.

The range of the ammeters should be ample for overload readings, particularly in cases where fluctuations are heavy. The charging current is limited, while the discharge current may rise to a very high value. Consequently the scales on these instruments may differ widely in order to accommodate this condition. They should, therefore, be chosen with considerable care, local load conditions determining the extent of difference in their respective scales. In large installations recording ammeters and voltmeters should be used.

Care and Maintenance.—The cost of a storage-battery plant, under general average conditions, will range between $10,000 and $50,000. This alone is sufficient reason for securing the best skill obtainable for the purpose of properly caring for so costly a piece of apparatus. Next in importance to first cost is depreciation. The depreciation of a storage battery is an uncertain quantity, and depends upon two things:

(1) The nature of service.

(2) The degree of care given the battery. The latter item is so important, in most cases, that the salary of the attendant for this work should not be the main issue, and it will be found that an attendant who is well paid will more than offset the extra pay by decreasing

the upkeep. Short-sightedness on the part of not a few managers and executive heads of departments has made this portion of the plant a wasteful instead of economical feature of the system, largely on account of employing underpaid and unskilled help.

It is true that where the conditions of service are severe, the deterioration is more rapid. This facts demands all the more vigilant attention to the battery than where steady loads are the rule. The rate of depreciation of a battery is anywhere from five or six per cent to fifteen or twenty per cent per annum. The lowest depreciation may be expected from a battery employed only for emergency use, while the highest rate will generally apply to extremely severe service, such as electric railway work.

The negative plates will ordinarily outlast the positives, and it will be found that there is considerable difference in the plates of the same battery, some of the positives lasting much longer than others. The negatives may be expected to last a great many years with but little deterioration; hence the average depreciation per negative plate is small in almost all classes of service.

For power-station service it is practice to employ Planté positives and Faure negatives, the latter signifying the "pasted" type, while the positive are "formed" by an intricate forming process. In electric vehicle work it is usual to employ pasted plates only. These are "forced" to a high capacity per unit weight of plate. On this account great mileage capacity is obtained at the expense of decreased life of the battery.

Battery-room Records.—Every battery plant should have daily records showing the charge and discharge periods, input and output and the condition of a "pilot" cell. Voltage and specific gravity readings should be taken of each cell at intervals sufficient to show its relative condition. The failure of any cells to do their part of the work should be carefully investigated and reported immediately. It is seldom necessary in a large plant to remove a complete cell, as defective plates can be withdrawn separately by having the plate terminal burned off by means of a blow pipe before the plate can be disconnected from the busbar. It is not necessary to make a detailed daily record of cells which are in good condition.

Overcharging the Battery.—In order to keep a battery in good working condition, it is advisable and in most cases necessary to overcharge the battery at regularly appointed periods, say, once a week to once in two weeks, depending upon the class of service. This process keeps down sulphation and reduces the cost of maintenance accordingly.

Ordinary full charge is readily detected by vigorous gassing at the plate surfaces, and more reliably by the specific gravity of the electrolyte. Great care must be used to prevent the battery from overdischarging at any time, as this is one of the most fruitful causes of sulphation and consequent deterioration.

(To be continued.)

[EDITOR'S NOTE.—This important series of articles was started in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, Sept. 3, 1910, and before its conclusion will cover every phase of central-station design.]

Fire Dangers of Steam Pipes.

Steam pipes in contact with wood are admittedly the cause of occasional fires, though manifestly it is impossible to make a definite statement of the relative hazard from this source. It must always be borne in mind that in fires, destruction is frequently so complete that the assignment of a cause is more or less a matter of conjecture. However, from our experience and that of others interested in this subject, there have been a number of cases in which steam pipes, under a variety of circumstances, have been without question a fire cause.

There is considerable diversity of opinion as to the circumstances under which such fires may be expected to occur, and the local conditions which contribute thereto. It is self-evident that the hazard is materially increased where the heat is in any way confined, or where contact is with materials more inflammable than wood. Particular care must be taken to guard against the presence of materials which are notably subject to spontaneous ignition, such as celluloid, coal dust, oily waste.

A number of investigators have attempted to produce fires by bringing steam pipes into contact with various combustible materials, but as the duration of the experiments was comparatively short, few actual fires resulted. The conclusions generally drawn, however, were that any steam pipe, no matter how low the pressure, would in course of time produce charcoal, and that when this stage was reached positive danger existed. Charcoal is unquestionably subject to spontaneous ignition. This is due largely to its peculiar ability to absorb from the air many times its own volume of oxygen. This is held in the minute pores, which exist in all forms of wood charcoal. The combination of this oxygen with the carbon may take place with sufficient rapidity to raise the temperature to the ignition point. Furthermore, charcoal formed at a low temperature is known to have a low ignition point.

Where steam is kept on a system continually there is less danger than where it is on intermittently, according to some investigators. The reason advanced is, that when allowed to cool the charcoal has a better opportunity to absorb oxygen than if kept hot at all times. Another factor is moisture. Experiments have shown that charcoal, once wet and dried out afterwards, is more dangerous than that which has remained dry, ignition points being well below the boiling point of water in a number of laboratory tests.

In our opinion reasonable precautions should be taken to keep steam pipes from contact with woodwork or other combustible material. This is of more importance with high pressure than with exhaust steam pipes, and more so in confined spaces than out in the open where there is free air circulation and freedom from accumulation of combustible dust and dirt.

There are two general methods of keeping steam pipes free from contact with combustible material, the first being through the use of an insulator, such as pipe covering, and the second by supporting them rigidly at a safe distance. Wherever pipes pass through concealed spaces, covering should preferably be carried for entire length, to avoid future contact with substances which may get into these spaces. On new installations solid covering and collars can be used, but if piping is already in place split covering, wired together, and split collars make the partial taking down of piping unnecessary. If desired, metal supporting plate can be used at ceiling instead of a collar.—*Quarterly of the National Fire Protection Association.*

The Condenser.

The advent of the steam turbine has greatly increased the importance attached to the condenser and its accessories, and their effect on the over-all efficiency of a power plant. Of course, even thirty years ago it was not unusual in marine-engine practice to meet with specifications which demanded the maintenance on the trial trip of a vacuum of twenty-eight inches or more, and by using a sufficient area of cooling surface it was found possible to secure quite high vacua even with condensers of what would now be considered very indifferent design. Very little attention had, however, been paid to the theory of condensation. Certain proportions were found to give what were considered reasonably satisfactory results, and these were adopted without question as to the possibility of attaining by a closer study of fundamental principles better results, from the commercial standpoint. The progress made during the past few years has, however, been most marked.

Formerly engine builders in attempting to secure a high vacuum generally followed one or other of two courses. In the first place, they increased the size of the air pump, or, secondly, they greatly augmented the already liberal allowance of cooling surface provided. The augmentation of the air-pump capacity proved at times singularly ineffective, for reasons which were not generally recognized. Dalton's law as to the pressure exerted by a mixture of gases or vapors was, it is true, established about 100 years ago, but the bearing of this law on the effect of an increase in air-pump capacity was not often appreciated. By Dalton's law, if a space is occupied by a mixture of two gases, each exerts exactly the same pressure on the walls as if the other were absent, the total pressure on the latter being thus the sum of the "partial" pressures of the two constituents. In a condenser the total pressure is practically the same at all points, but at the top the space is occupied almost wholly by steam, whilst at the bottom there is a considerable percentage of air, and this has a most prejudicial effect on the efficiency of the tubes. The rate of transfer of heat from air to the tubes appears to be only about one-thousandth as great as is the rate of transfer when air-free steam condenses on the surfaces exposed to it. The presence of air causes the temperature at the bottom of the condenser to be less than at the top.

Whilst it has long been recognized that high vacua were profitable in the case of steam turbines, there has been no such general agreement as to their advantage when used in connection with the reciprocating engine. In fact, it has been found repeatedly that though a reasonably high vacuum improved the engine economy, its effect on the coal bill was the reverse of favorable; and under ordinary conditions at sea the total coal consumption, with a vacuum as low as twenty inches, is not materially greater than when the vacuum is twenty-five inches. The loss on the engine is, in fact, made good by the hotter temperature of the feed. Further, other experiments have shown that in certain cases an increase of vacuum to above twenty-four inches did not in any way improve the engine economy, the weight of steam required per indicated horsepower-hour being practically unaffected. Other experiments have, however, shown a continuous increase in steam economy, even when the vacuum has been pushed up to twenty-eight inches or over. The discrepancy is doubtless due to the exhaust ports and passages of some engines being too small to pass the steam when its specific volume is large. As is well known, the weight discharged from a given aperture in a second becomes independent of the external pressure when the latter falls below about 0.6 of the internal pressure. If the ports and passages of an engine are only large enough to permit the pressure inside the cylinder to fall to four inches absolute on the exhaust stroke, then a further lowering of the condenser pressure will give no increase in the power developed.—*Engineering.*

Electrical Development in Argentina.

In a report contributed to the *Electrotechnishe Zeitschrift*, Dr. Berndt credits the Argentine Republic with electrical generating plants aggregating 75,300 kilowatts. Of these, 47,000 kilowatts are installed in the city of Buenos Ayres; 21,900 kilowatts in the state of the same name, and 6,400 kilowatts in the state of Mendoza; thus the remarkable concentration of all industrial enterprise in the metropolis is strikingly noticeable. Buenos Ayres with environs has a population approaching three millions; the population of the country is only six millions. The prime movers of the country aggregate 99,000 kilowatts. Steam turbines predominate; then follow reciprocating engines, water turbines and gas engines. These engines came chiefly from Italy, Germany, and England, the electric generators from Germany (seventy-seven per cent) and England (twenty-two per cent).

New Power Station for the Minneapolis General Electric Company.

The principal equipment of the new power station of the Minneapolis General Electric Company to replace the station destroyed by fire on January 7, has been ordered by the Stone & Webster Engineering Corporation, which has charge of the design and construction.

There will be two 6,000-kilowatt Allis-Chalmers turbo-alternators generating current at 2,300 volts, which will be stepped up to 13,000 volts by 2,500-kilowatt Allis-Chalmers transformers, of which six will be installed.

The boiler equipment consists of ten 600-horsepower Babcock & Wilcox boilers supplying steam at 180 pounds working pressure. The steam will be superheated 125 degrees by Foster superheaters.

The turbine room will be supplied with a four-motor Cleveland Crane & Engineering Company traveling crane with a sixty-ton main hoist and a fifteen-ton auxiliary hoist.

The building will be of steel frame and brick construction and the stacks will be of steel.

Combined Garbage Destructor and Electrical Plants.

A recent consular report states there are now eighty plants in the United Kingdom for the conversion of garbage of cities into electric power, and that they are increasing at the rate of twenty a year. An English mechanical engineer calculates that there is a long ton of refuse for every 1,000 inhabitants, equal to about 300 pounds of steam per hour for nine hours per day, if destroyed in the properly designed destructor. A technical review of the subject has been compiled by Consul Halstead, and will be loaned by the Bureau of Manufactures to those interested.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

SIMPLE METHOD OF DETERMINING LUMINOUS FLUX FROM POLAR CURVES.

BY W. E. BARROWS, JR.

Since the comparison of the illuminating values of the various sources of artificial illumination is based upon the total amount of light emitted, some simple, yet accurate and convenient, method of determining the amount of luminous flux from any given polar

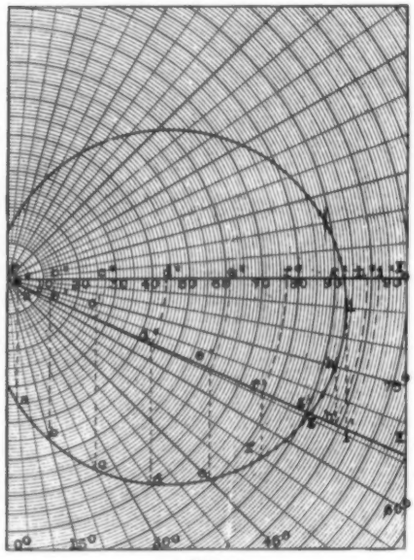


FIG. 1.

light-distribution curve will be found of great assistance to the man involved in problems of this nature.

It can be shown that, if the area of a sphere be divided into a certain number of zones, each subtended by equal angles, the area of any zone will be equal to a constant multiplied by the sine of its bisecting angle measured from the nadir. The value of the constant depends upon the number of zonal subdivisions. Applied to the subject under consideration the flux in any zone in lumens becomes

$$F_{ab} = KI \sin \frac{a+}{2}$$

where a and b are the angles, from nadir, locating the zone, I is the average candlepower in the zone, F_{ab} is the flux in lumens, and K is a constant, equaling 1.098 for ten-degree zones.

In Fig. 1 is shown an application of this equation conceived by the writer which possesses a maximum of simplicity and an accuracy comparable with any of the graphical methods of determining the mean spherical candlepower values or the luminous flux available from an illuminant.

The distribution of light is here assumed to be uniform in azimuth and of such values in a vertical plane through the source, as indicated by the curve a, b, c, etc. The spherical surface is divided into ten-degree zones and the average zonal values of the candlepower represented by the radial lines, Oa, Ob, etc. If these midzone values be projected vertically onto the line OK and the extremity of each projection be continued around O along the arc of a circle into the horizontal, the value of the flux in lumens in any zone will be represented by the corresponding distance, to the same scale as the polar curve is plotted, along the horizontal OX measured from O.

As an example of the manipulation of this method, consider the zone between the angles of 40 and 50 degrees from the vertical. Assume Oe (equal 79) to be the average intensity in this zone. Its projection on OK is equal to Oe' and this value transposed to OX will be Oe'' or 61 lumens. In the same way the flux in the 50—60 degree zone will be 77 lumens. By adding the lumens in the different zones together the total lumens in the lower hemisphere may be obtained. The flux in lumens in the upper hemisphere may be found by projecting the midzone values upon the line OK or upon another line 24° 20′ above the horizontal, and transposing to the horizontal as above.

The simplicity of this method is manifest. The only apparatus necessary is a pencil and piece of paper and the only calculation is simple addition of the nine or eighteen values obtained. A right-angle triangle will be found useful in securing the projections upon the line OK, but a corner of a sheet of paper, even the sheet on which the curve is plotted, may be conveniently substituted.

It is obvious that this method may be applied to any distribution curve plotted upon polar-co-ordinate paper. In this case a series of vertical lines together with the radial line (Fig. 2) laid on a quadrant of transparent celluloid, tracing cloth or similar transparent material will greatly facilitate operations.

Since the secant of 24° 20′ is approximately 1.1 (1.098) the midzone values may be projected directly onto the horizontal line and the sum of the projections multiplied by 1.1 and the same results obtained as above.

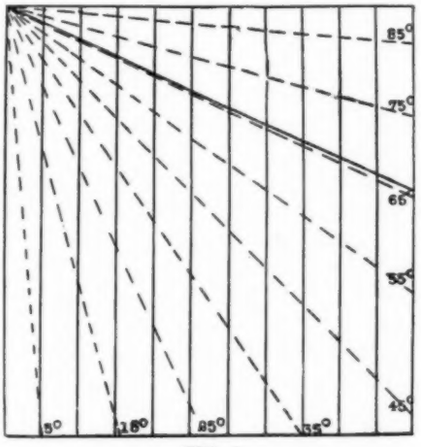


FIG. 2.

The mean hemispherical candlepower may be found by dividing the lumens in the hemisphere by 2π (6.28) and the mean spherical candlepower by dividing the total light flux of the lamp by 4π (12.56).

The application of this method to the solution of problems to determine the number of lamps required for an installation by means of the flux-of-light method will at once be obvious. It is now common knowledge that in

the flux-of-light method the total flux in lumens required to light a given surface is equal to the average illumination in foot candles multiplied by the area in square feet. This value divided by the number of effective lumens from each of the chosen illuminants will give the number of lamps required for the installation. The value of the effective lumens may be easily calculated by the preceding method if the solid angle, with the source as an apex, which includes the illuminated surface, be known.

Assume that in the case of a small room all of the light below the forty-degree meridian will be available for illumination on the working plane. Then by adding the values of the flux in the four ten-degree zones below the forty-degree meridian obtained as indicated above, one may easily find the number of effective lumens per lamp. Then the total flux required divided by the amount available from each lamp will give the number of lamps in the installation necessary to give the desired illumination.

Unique Tungsten Street Lighting Proposed in Leavenworth.

The local lighting company of Leavenworth, Kan., has proposed the lighting of Delaware Street from the Union Station to Sixth Street by means of sixty-watt tungsten lamps to be placed uniformly every twenty-five feet on each side of the street. To attain this uniformity of spacing the lamps are to be suspended from two continuous cables, one on each side of the street, that will be supported directly over the curb lines by brackets on the trolley poles. The lamps will be provided with metal shades to direct the light entirely upon the sidewalk and roadway. Between Fifth and Sixth streets, where there are no trolley poles, suitable posts are to be erected. The lamps will be lighted from dusk till midnight on Saturdays and from dusk till 11 p. m. on the other six evenings of the week.

The entire installation is to be put in, operated and maintained by the company on a three-year contract at $1 per lamp per month for the first two years and at eighty cents during the third year. The proposition has been favorably received by the business men of the street, and the Greater Leavenworth Club is practically pledged to push it through.

The Philadelphia Company Section Meeting.

The regular monthly meeting of the Philadelphia Electric Company Section, National Electric Light Association, was held on February 20. The reports of the committees were submitted, those of chief interest being the reports of the Membership and the Awarding of Prizes Committees. The Membership Committee reported that the total membership to date is 420, there having been 154 applications favorably acted upon since September 1, 1910. The Committee on the Awarding of Prizes reported that 19 suggestions were received and three awards made as follows: First prize, E. S. Wilson; second prize, W. M. Barnes; third prize, Geo. C. Finley.

The winning suggestion was to the effect that a competent representative visit each new consumer after the first monthly bill has been delivered in order to be assured that the service is satisfactory, and if possible to interest the new consumer in electrical devices, such as electrical irons, chafing dishes, coffee percolators, etc.; also that a central incandescent-lamp station be located, at which all renewed lamps should be graded and redistributed.

The suggestion winning the second prize was that in each issue of *Current News* a part should be set aside for the latest electrical developments, attaching thereto a short description which would place before every employee of the company the most modern electrical devices as developed.

The third suggestion covered data for solicitors, suggesting that a loose-leaf book be developed in which could be placed illustrations of modern devices, such as shades, signs, photographs of interior and exterior lighting, etc.

The paper of the evening, "The Work Involved in Handling Consumers' Accounts by the Tabulating System," by H. R. Kern, was ably presented, and covered that branch of company accounting pertaining to the consumer in a very thorough manner. Each step, for both the billing of current, and for the billing of merchandise, was carefully analyzed; many troubles were pointed out, particular emphasis being given to the many delays which are apparently of little importance, but which materially affect the work of the Accounting Department. The Hollerith Tabulating System, as applied to the work of the Philadelphia Electric Company, was described, and proved most interesting.

Mr. Cremer, representing the Hollerith Company, made a brief address, in which he outlined the history of the Hollerith Tabulating Machine.

On March 1, at the Commercial Department Branch meeting, a lecture by Nelson B. Hazeltine, of the Holophane Company, was presented, the subject being "Reflecting and Diffusing Mediums for Artificial Illumination in the Home." On March 2, the Accounting Department had its meeting, including papers and also a short sketch entitled "His Model Wife."

New York Company Section Meeting.

The New York Company Section of the National Electric Light Association held its third regular monthly meeting on February 20, at the Edison Auditorium. About 300 members and their friends were present. The meeting was opened by Chairman Arthur Williams, and after a short business session, C. E. Allen was introduced and delivered an able address upon distributing transformers, illustrated with a number of good lantern slides. Henry Schroeder followed with an illustrated lecture on incandescent lamps, giving the history of the art of their manufacture from the beginning up to date. The subjects were presented in a clear and forceful manner by the speakers, and the thanks of the Section were extended to each.

A vaudeville performance was then given, followed by a very nice and tasty luncheon with cigars. This is the first social meeting the Section has had, and it proved a great success.

This Section bids fair to become one of the largest and strongest in the Association and the membership of 580 is expected to reach 1,000 before many months.

Public Utility Taxation in New York.

The total tentative assessments for public service companies in Greater New York for the year 1910 was $465,409,600, and the amount estimated for the present year is $483,908,300. The largest estimate for any electrical company was that made for the Manhattan Railway Company. The property of this concern is evaluated at $78,512,500.

TELEPHONY—TELEGRAPHY, and WIRELESS.

A "TELEPHONE AUTHORITY" FOR GREAT BRITAIN.[1]

BY HERBERT LAWS WEBB.

At the present time the State is expending approximately a million a year in providing business men and the racing community with telegrams at under cost price. It is well-known that the principal users of the telegraph service are business people and that section of the community which bets on horse races. It is also generally known that the telegraph service is conducted at a large annual loss, but it is not so well known how this state of affairs has arisen.

It has come to be regarded as a natural thing—a sort of divine right—that the telegraphs of a country should be a Government monopoly, but there is no real reason for this. All the pioneer work in telegraphy was done by private enterprise, the submarine cable service of the world is operated—and operated at very high efficiency—by private enterprise, and the telegraphs of North America, both of the United States and of Canada, are operated by private enterprise and apparently with satisfactory results to the public. In many Continental countries, where the Government is extremely centralized and the local government really depends on headquarters, the telegraphs are an important part of the political machine and the public telegraph service is, so to speak, a by-product, and often a by-product of very inferior quality. These conditions do not apply in this country, where there is no necessity for the Government to control the telegraphs in order to communicate with the governors of provinces or prefects. There has never been a suggestion that Government control of the telegraphs here was a political necessity, and the present State telegraph monopoly was set up forty years ago as a business proposition; and it is as a business proposition that it should be judged, both because it is just that the users of the telegraph service should pay a proper price for the facilities and because such an important electrical industry should be worked under sound financial conditions.

The State telegraph monopoly had its origin in 1865, when the late Frank Ives Scudamore, then a Second Secretary of the Post Office, was directed to report whether in his opinion "the electric telegraph service, might be beneficially worked by the Post Office, whether, if so worked it would possess any advantages over a system worked by private companies, and whether it would entail any very large expenditure on the department beyond the purchase of existing rights."

Mr. Scudamore was an enthusiast but not a business man, and his report was strongly in favor of the acquisition of the telegraphs by the State, and he prepared estimates to show that the telegraph service in the hands of the State would be what the City would call a safe business proposition. As a matter of fact, the result has been a total expenditure up to date, for capital expended and unextinguished, for loss of interest and for excess of working expenditure over receipts, approximately $170,000,000. The asset against this is the telegraph system of the Post Office as it exists today, but, as already noted, the system is being worked at a large and increasing annual loss.

Mr. Scudamore's first estimate was that the properties of the six telegraph companies then existing could be acquired for 12 millions and worked at a sufficient margin of profit to provide interest on the money and sinking fund for extinguishing the capital. The second estimate, made two years later, brought the capital required up to $15,000,000, but still showed sufficient margin of profit to meet interest and sinking fund, as a net revenue of nearly six per cent was calculated.

Table I shows how completely these expectations were falsified in actual practice. The ratio of expense to gross revenue in the first estimate was put as high as 67.5 per cent, and in the third was reduced, with no apparent justification, to 51.5 per cent. The remaining figures in the table show how completely unreliable all the estimates were as a guide to the actual financial results of the State telegraph monopoly. When the Telegraph Act was passed the maximum capital expenditure was put at $34,000,000 but within a very few years it grew to almost $53,000,000 and a very large proportion of this was spent in extending the telegraph system after it passed into the hands of the Post Office. The increased capital expenditure would not have mattered if the estimates of working expenses had been justified in practice; but, as will be seen, the working expenses rapidly and steadily increased.

TABLE I.—ESTIMATED AND ACTUAL GROSS REVENUE AND WORKING EXPENSES.

	Gross Revenue.	Working Expenses.	Expense in Per Cent of Revenue.	Surplus.
Mr. Scudamore's Estimates:				
1866 First	$3,290,000	$2,220,000	67.5	$1,070,000
1868 Second	2,960,000	2,070,000	70	890,000
1869 Third	3,580,000	1,840,000	51.5	1,740,000
Actual Results:				
Year 1870	2,970,000	1,700,000	51.8	1,270,000
" 1871	3,580,000	2,400,000	67.2	1,180,000
" 1872	4,730,000	4,050,000	86	680,000
" 1873	5,100,000	4,650,000	91	450,000
" 1874	5,670,000	5,050,000	89	620,000
" 1879-80	7,150,000	5,500,000	77.2	1,650,000
" 1889-90	11,300,000	10,100,000	89	1,200,000
" 1899-1900	16,180,000	16,620,000	103	*440,000
" 1908-1909	21,000,000	23,480,000	112	*2,480,000

*Deficit.

The reasons for the failure of the Government to run a business on business lines are several, but they may be summed up in the general statement that

[1] Abstract of a paper read before the London (England) Chamber of Commerce, February 17, 1911.

under political control a technical business cannot be operated on business lines. There is constant pressure brought by the public or by bodies having political influence to obtain reduction in rates, and there is constant pressure brought by the staff to obtain improvements in pay and conditions. Moreover, it is a well known fact that the same general efficiency of staff cannot be obtained in a Government Department, where employment is permanent, as can be obtained in private employ, where pay and promotion depend upon efficiency. Some of these causes were very early at work in the State telegraph monopoly, as within four years the working expenses have more than doubled, although the increase of traffic was only fifty per cent.

A fact which is a crushing indictment of State ownership of a technical industry is that notwithstanding all the improvements which have been made in telegraphy in the past forty years the working cost per message is higher today than it was forty years ago. The message of today averages not much over half the length of the message of the old days. During the past forty years there have been innumerable improvements in telegraphic methods and appliances. The use of hard-drawn copper wire instead of iron wire, the adoption of duplex, quadruplex and multiplex working, the Wheatstone automatic system and other systems of rapid machine telegraphy have all tended to increase the output of the telegraph plant. Yet with all these advantages and with an average message of about half the length, the working cost per 1,000 messages is today $210, as against $195 in 1870.

Such is the financial working of a State monopoly in which in one way and another some 170 millions of money have been sunk, and which has a present revenue and expenditure approaching five millions a year. Before discussing the effect of the existence of this monopoly upon other means of electrical communication, it is worth while to take one more dip into history on the question of monopoly. When it was first proposed that the State should acquire and work the telegraphs, a monopoly was not asked for. In fact, the Post Office disclaimed the desire for a monopoly, and argued that in efficiency and economy they would be able to beat all comers. In the following year the Post Office pressed for a legal monopoly, on the score that without a monopoly opposing schemes might be started for the purpose of being bought out. The monopoly clause was inserted in the Telegraph Act of 1869, and henceforward electrical communication became a State monopoly under the control of the Postmaster-General.

EFFECT OF THE TELEGRAPH MONOPOLY ON THE TELEPHONE INDUSTRY.

Some years after Parliament granted the Postmaster-General a monopoly in telegraphs the telephone was invented, and when companies were organizd in Great Britain to put this marvelous invention at the service of the public the Postmaster-General brought suit against these companies for infringement of his telegraphic monopoly. The result was that the telephone was found to be legally a telegraph within the meaning of the Act, and the telegraph companies had to accept the Postmaster-General's terms or give up their business. At that date (1880) the Postmaster-General had acquired sufficient experience of the unprofitable nature of the telegraph business under Government ownership to be unwilling to experiment with a new invention, the commercial capabilities of which his advisers distrusted. Consequently, the Post Office did not at once go into the telephone business, but licensed the telephone companies to continue the business under very rigorous terms and conditions. From the very beginning, however, the telephone was looked upon as a competitor of the telegraph and was compelled not only to pay tribute to the telegraph, but to remain in a relatively subsidiary position. A royalty of ten per cent of the gross receipts from telephone business had to be paid to the Post Office and the telephone was forbidden to be used for written messages, and numerous other difficulties and restrictions were imposed. Probably the greatest of these difficulties, and one which has worked the most harm to the development of the telephone, was that statutory powers for the telephone companies to run their wires were refused them. All efforts to obtain these very necessary statutory powers have been consistently opposed by the Government. Another great difficulty, which has become increasingly acute as the present year has approached, was that the license was made for 31 years from 1880, terminating on the last day of 1911, but no provision was made for the continuance or conduct of the telephone service after the expiry of the license. The Government reserved the power in the license to give notice of their intention to purchase the telephone business at intervals of seven years, but this option has never been exercised. The telephone companies therefore have been in the unfortunate position of carrying on a difficult technical industry under these great adverse conditions of lack of statutory powers and of a limited life with an uncertain end. These conditions have completely prevented any broad policy of development of the telephone and the British public have been the sufferers.

At the present time we have 644,000 telephones in service in the United Kingdom, whereas if the telephone were developed in the same ratio in proportion to population as it is in the United States, we should have nearly 3,000,000 telephones in service, and consequently vastly improved means of communication, in every city and throughout the whole country, compared with those which now exist.

In 1899 came the late Mr. Hanbury's policy of municipal competition and of Post Office competition with their own licensee. This policy was frankly intended either to make the purchase of the Telephone Company's system at the end of the license an easy matter, or else to render it unnecessary for that purchase to be made at all. When it became clear that this policy had failed the Agreement of 1905 was made. Under this Agreement the National Telephone Company engages to sell its plant to the Postmaster-General at its value as working plant, and the present aspect of the telephone business is that within a short time it will become a complete State monopoly.

No business man looks forward without misapprehension to the establishment of a State monopoly in the telephone. No business man expects either the high efficiency or the wide development of the telephone which his business interests require, if the telephone industry is to be subject to political control and to the uncommercial methods of a Government department. We have drifted into the present position through the unfortunate error made forty years ago of granting the Post-

Office a legal monopoly in the telegraph, a step which by many was considered an error at the time, and which was totally unnecessary if the State had been capable of operating the telegraph business efficiently and economically. Even if the Government telephone service showed a profit, it would still not be developed at the rate necessary to meet the business requirements of the country, for the simple reason that the financial control would vest in the Treasury and not in those directly responsible for the conduct of the business; Treasury control of public money must in its nature be narrow and rigorous, and cannot be stimulated by the commercial considerations which are of the first importance in dealing with a rapidly expanding enterprise.

THE REAL REQUIREMENTS OF THE TELEPHONE SERVICE.

There has been some discussion lately in different parts of the country of a single aspect of the telephone question, the question of rates. To the business man this is by no means the most important part of the subject. The business man wants a highly developed and highly efficient telephone service. He wants to be able to reach by telephone everyone with whom he has business and to reach them quickly and effectively. If he has that general and efficient service he is perfectly willing to pay a fair price for it. To bring the telephone service of Great Britain to the pitch of development and efficiency which the commercial interests of the country require, that is, to plant five telephones for one that is now working, will require a large expenditure of capital and an enterprising and progressive management. To secure this flow of capital—several millions a year for many years to come will be required—and to secure the progressive management necessary for the upbuilding of the service, it is essential that the solution of the telephone question shall be on commercial lines and not on those of a State-owned monopoly. Much prejudice has been aroused against the extension of the telephone license to an ordinary private company, and there is a large body of public opinion which is opposed to State monopoly. A solution can be found to meet both views.

A TELEPHONE AUTHORITY FOR GREAT BRITAIN.

This solution consists in creating a Telephone Authority on the lines of the Port of London Authority, which would take over the telephone plant both of the National Telephone Company and of the Post Office, and would operate and develop the telephone service of the whole country on commercial lines.

The present position of the telephone business is that four-fifths of the local service is conducted by the National Telephone Company, the Post Office owning the trunk lines and portions of some of the local systems. Of municipal telephone systems there remain but two, those of Hull and Portsmouth, which are operated in competition with the National Company's systems in those towns. Under the agreement of 1905 the National Company is to sell its plant at the value that may be fixed by arbitration. The Telephone Authority would take over not only the plant of the National Company on the terms and conditions fixed by the agreement, but also the telephone plant of the Post Office and of the two municipalities on similar terms. The whole system would then be consolidated and operated by one organization, which would have for its single obect the development and improvement of the telephone service of the whole country.

The financial operation involved would be of considerable magnitude, but presents no insuperable difficulties. When the valuation of the plants is arrived at the Telephone Authority could exchange its stock for the existing securities or could raise money if necessary to purchase the plants for cash. In the case of the Post Office telephone plant some difficulty might be found by the Government in parting with its property except for cash, but this point might be got over either by the Telephone Authority assuming responsibility for the terminable annuities on which the Government telephone capital has been raised, or by issuing in exchange for the Government telephone plant debentures redeemable at an early date.

The difficulties which there may be in dealing with the present capital of the combined telephone business of the country, are nothing compared with the advantages of placing the whole telephone business under a single Telephone Authority which would be a commercial body and would readily obtain the continuous flow of new capital necessary for the rapid development of the telephone service throughout the country. For some years past the telephone business has been almost in a state of arrested development. To provide for the real needs of the country in telephone facilities and to bring the entire service to an adequate pitch of efficiency will require the expenditure of several millions of capital every year for many years to come. Such a flow of capital can only be obtained if the enterprise is to be a productive one, and it can only be productive if operated under commercial conditions. If operated under commercial conditions, giving continuously improving facilities to the public at reasonable rates, and economically administered, it is certain to be productive, and consequently there will be no difficulty in obtaining the continuous supply of capital necessary for wide development. The dividends would be fixed at a figure which would tempt the investor, and if excess profits are made as the result of more economical methods of conducting the service, part of such excess profits could be devoted to a bonus on the capital and part to a reduction of rates or to the increase of facilities for the benefit of the public.

It is not possible to develop fully in the course of a brief paper all the advantages of the proposal which I have outlined, but I might summarize them as follows:

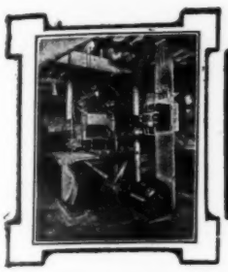
(1) The interests of the public would be more effectively safeguarded than under a Government monopoly.

(2) By maintaining a commercial organization the development of the telephone service would be continued more rapidly, more economically and more efficiently.

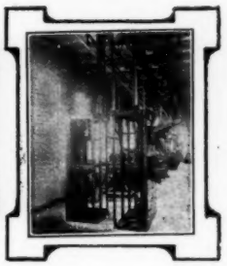
(3) The Post Office would be assured of a growing income in royalties. Under Post Office ownership a deficit on the working of the telephones would probably occur, as has happened with the telegraphs.

(4) Direct political control being eliminated, the development of political agitation and pressure on Members of Parliament, already an evil of considerable magnitude in the Post Office, would be arrested so far as the telephone staff is concerned.

(5) A large body of skilled workers would be employed under conditions promising steady improvement and development with the rise in magnitude of the industry.



Industrial Power



MINE PUMPING IN THE SOUTHWEST.

BY J. E. BULLARD.

Over two-thirds of all the spelter zinc used in in the United States is mined in the southwest Missouri district. The mines are worked at present at an average depth of 200 feet. Into practically every mine flows a fairly large amount of water. This water must be pumped out before the mine can be worked, a fact which gives a vague idea of the importance to the mine operator of keeping his mine dry. However, before we take up the question of pumps, we will further consider the importance of pumping and the quality of the water to be pumped.

Water in a mine is a great deal like snow on a railroad track. The income ceases and the expense increases. As an illustration we will take a mine worked at the 200-foot level. This mine supplies dirt to a 200-ton concentrating mill and has been worked for five years. In other words 500 1,000-pound cans have been hoisted twenty-six days a month for sixty months. This gives a total of 780,000 cans and as each can holds enough dirt to displace seventy gallons of water it will require 54,600,000 gallons to fill the space left. The regular flow of water we will assume to be 400 gallons per minute or 17,280,000 gallons per month. If, then, the mine is full of water and we pump it dry in a month it will be necessary to pump the 17,280,000 gallons of regular flow over and above the 54,600,000 gallons standing in the mine. The average cost of electric pumping under these conditions is 1.5 cents per 1,000 gallons. It, therefore, will cost $259 to pump the 17,280,000 gallons and $819 to pump the 54,600,000 gallons. This gives a total of $1,078 and makes no allowance for water held in pores of the rock, in natural caves and in adjoining mines which will flow in and materially increase the cost.

In the early days of mining in the southwest Missouri district the mines were shallow and most anything answered fairly well for a pump. Most of the pumps then used were modifications of the bucket elevators now used in the mills. Since those days the crudest pumps have been discarded and the cruder ones are gradually following in their wake. The pumps now in common use are lift and walking-beam pumps, steam pumps and centrifugal pumps.

Lift and walking-beam pumps show a high efficiency and when driven by gas engines the fuel cost is very low. Nevertheless, the shut-downs for repairs to either the engine or the pump make this method very expensive. The pump and the engine cannot be relied upon for continuous operation but water is constantly flowing into the mine and unless a steam pump is kept in readiness to start immediately, whenever the other pump goes down the money spent for pumping will never yield results. A lift pump driven by an electric motor or a steam engine is much more reliable but is not practical for mine pumping. The lift pump does not give the same satisfaction for mine pumping it does for pumping from deep wells. This is true for two good reasons: First, mining the ore causes the earth above to settle and sometimes to cave in with the result that the drill hole containing the pump tubing cannot long be kept straight; secondly, the dirty water, the blasting, and the rough usage the miners are likely to give it are bound to cause the pump to give trouble.

Pumping with steam pumps is the most inefficient method used. The steam pump itself is very inefficient and the long line of steam pipe leading to it allows a great deal of condensation. The average pipe line is about 300 feet long and poorly insulated if insulated at all. It is, therefore, safe to add to the horsepower of the pump four horsepower per hour for condensation in the steam line. This makes the cost of pumping with steam run from two cents per 1,000 gallons for the most economical installations having short well insulated lines up to 5 cents or more for the less economical ones having long steam lines. Aside from the cost of pumping, the steam pump has some advantages. It is not materially injured by remaining for some time under water. If the pump is below the surface of the water it can be operated with compressed air till it is uncovered and it will not be necessary to install another pump. The increased cost of pumping, however, more than offsets all the advantages the steam pump has over other forms of pumping.

Both the vertical and the horizontal centrifugal pump are now coming into general use. In the older installations of centrifugal pumps the horizontal pump was used exclusively. It was belt-driven and inefficient. Tests made at two mines show the following results: One pump was running on a by-pass and showed a combined efficiency of fifteen per cent. When the by-pass was closed the combined efficiency rose to fifty-eight per cent. At the other mine the efficiency was forty-five per cent, and it is safe to state that none of the old installations will show a combined efficiency of more than forty-five per cent.

The new pumping installations in old mines are practically all direct-connected motor-driven horizontal pumps. A great deal more care is taken with these and their efficiency will run from fifty per cent up. In figuring on these new installations central stations use the formula

$$H.\ P. = G.\ P.\ M. \times H/2000$$

H. P. is the power required to be put into the motor to do the work; G. P. M. is the gallons per minute and H. is the total head. This allows about fifty per cent for the combined efficiency

and places the current consumption as high or higher as it proves to be after the installation is running.

The centrifugal pump is the ideal mine pump. It can be direct-connected to a motor, thus doing away with all belts and leaky steam lines. It takes up little room, requires little attention and is very nearly fool proof. The power used varies with the quantity of water pumped rather than with the head against which it is pumped. This means that if the discharge pipe is completely closed the power consumption will decrease and there will be no danger of burning out the motor. Again, the power consumption is not dangerously increased if the discharge pipe is broken close to the pump case.

The rate of flow from a centrifugal pump may be regulated in two ways. Vary the speed or throttle the discharge. The most satisfactory results are obtained by running the pump at its greatest efficiency and shutting down after the water is pumped out, but where there is not sufficient space in the mine to store water and the total flow of water must be pumped out as fast as it runs in, the most satisfactory way is to regulate the pump by throttling the discharge. This is true in spite of the fact that varying the speed may at some points actually raise the efficiency of the pump and that throttling always lowers the efficiency. In a mine it is advisable to have everything as simple and rugged as possible and for that reason the motor with a squirrel-cage winding has more advantages than the gain in efficiency which might be obtained by installing the best variable-speed motor. If due care is taken in selecting a pump the quantities of water necessary to pump can be handled without too great a sacrifice in efficiency. The efficiency of a pump when working on a throttled discharge may be found by the following formula.

$$Et = En \times Hu/Ht$$

Et is the efficiency obtained from the pump when throttled. En is the highest efficiency the pump will give when delivering the required amount of water at the given speed. Hu is the actual head utilized and Ht is the head at which the pump would deliver the water or the head which is caused by throttling. As an example we will take a ten-inch single stage pump running at 1,125 revolutions per minute. This pump shows an efficiency of sixty-five per cent when delivering 800 gallons per minute against a head of 113 feet. If the discharge is throttled so that this pump delivers this quantity of water against a head of 100 feet our formula gives an efficiency of 57.7 per cent.

At this pump efficiency, if we have a direct-connected motor of ninety per cent efficiency, we get a combined efficiency of over fifty per cent. With a little study of the characteristic curves of the different size pumps and a knowledge of the amounts of water to be pumped, together with the variation in quantity, it is possible to so arrange the pumping installation that the combined efficiency is always above fifty per cent even when the pump is throttled.

In spite of the fact that natural gas with a heat value of 1,000 B. T. U. can be purchased during the greater part of the year at 12.5 cents per 1,000 feet for boiler firing and that it is supplied throughout the year at twenty-five cents per 1,000 feet for gas-engine use, nearly all the mine operators are becoming boosters for electric pumping. This has been brought about by giving them the very best service and placing at their disposal free of charge all the engineering advice necessary to decide on the best and most economical installation.

Electric-Furnace Steel in Mexico.

A contract has been made by the Mexican Government for the establishment in that country of a factory for the electrical production of iron and steel. The concessionaire, who is an Englishman, owns large iron-ore deposits, and undertakes within two years from the date of the concession to produce manufactured iron in his factory, by electrical process, at the rate of not less than 1,200 tons per annum. Machinery, material, etc., for the building and equipment of the works may be imported free of duty. The contract is for a period of ten years.

Government Hydroelectric Project in New Zealand.

The New Zealand Parliament has appropriated $1,500,000 for hydroelectric developments in that country. A project to supply the City of Christchurch from Lake Coleridge will probably be completed first.

Alternating-Current Motors for Elevator Service.

At the last meeting of the Pittsburg Section, American Institute of Electrical Engineers, the subject of discussion was "Alternating-Current Motors for Elevator Service." A paper by W. H. Patterson discussed the characteristics of the motors which are applied to this service and described the control systems used.

Squirrel-cage motors used for this service are designed with high-resistance end rings so as to develop maximum torque at starting. They will develop about twice full-load torque and take about 2.5 times full-load current, when connected directly across the line. The control is by a simple reverse switch, thereby replacing the more expensive controller and rheostat required by a phase-wound motor. It is important that the torque be the maximum at the start, for though the efficiency may be slightly improved by decreasing the rotor resistance, the motor would not then start with as heavy loads. Moreover, as the required torque decreases after starting, an increased torque of the motor would cause a very sudden and disagreeable acceleration.

Performance curves were shown. It was stated that the best results were obtained when the slip is about twenty per cent. The full-load power-factor was shown to be about eighty per cent and full-load efficiency about seventy per cent. While the apparent efficiency is low, it should not be compared with that of constant-speed motors, as in this service efficiency is unimportant compared with the other characteristics. The efficiency of the elevator machine itself approximates fifty per cent. The power-factor at starting varies from seventy to eighty per cent.

Performance curves of the wound-rotor type were shown. These have somewhat better starting conditions, developing twice full-load torque with about twice full-load current. The conditions governing the size of motor required were discussed. It was shown that the nominal rating is of slight importance compared to the starting torque developed. The service conditions must then be considered to make sure that the operation is not continuous enough to cause the motor to overheat.

Squirrel-cage motors are made in sizes up to eighteen horsepower, this

being the practical limit due to starting current. They are used for freight elevators up to speeds of 100 feet per minute and in passenger service up to 150 feet per minute. The wound-secondary type is satisfactory for elevators of all capacities up to 250 feet per minute. Elevators operating at higher speeds are practically always two-speed machines, which feature immediately eliminates the alternating-current motor, since with any given resistance in the rotor circuit, the speed will vary with the load. Another feature limiting the use of alternating-current motors is the fact that with them dynamic braking can only be accomplished by the use of a small motor-generator set to supply direct-current excitation to the primary. However, alternating-current motors have been in use in elevator service for several years and have thoroughly demonstrated their adaptability for conditions within their range.

In introducing the speaker, Chairman Muller commented briefly upon the importance of the subject to the central station. The adaptability of the alternating-current motor for this service may influence greatly the use of direct or alternating current for a large part of the distributing system of large stations.

F. E. Towne, of the Otis Elevator Company, described the magnet control of slip-ring motors and commented upon the difficulties in their application as compared with direct-current motors, particularly with regard to braking.

H. D. Janes gave an interesting review of the development of alternating-current-motor application, dealing with the commercial as well as the engineering features. He emphasized the importance of safety and reliability in this service, since failure might mean loss of life. This had probably retarded the development, because no changes which might possibly reduce the factor of safety could be tried.

J. E. Martin, of the Allegheny County Light Company, presented some facts from the standpoint of the central station. He stated that the elevator load of a central station is generally confined to a district remote from other power loads; these same districts invariably having the most dense lighting load. In fact, the elevator load follows very closely the development of the lighting load and maintains a fixed ratio of about eleven per cent of the total connected load. The load-factor averages about forty per cent against twenty-four per cent for lighting, and the demand factors have a smaller difference. One of the peaks of the elevator load overlaps the lighting peak. It is highly desirable to use one distribution system in districts where elevator load is found. The greatest disadvantage to be met in carrying out this principle is the intermittent nature of the load. On a circuit having an elevator load exclusively, the weight of copper has to be greater for a given load than for any other kind of service. It has been found advantageous and satisfactory to combine the elevator load with lighting and miscellaneous motor load if the elevator load does not exceed five per cent of the total. This low limit is due to the heavy starting current. This shows how important are these starting characteristics, and how desirable to improve them.

There was further discussion by M. W. Bartmess, T. Varnye and R. E. Hellmund. It was brought out that the high power-factor at starting of the elevator motor as compared with that of most squirrel-cage motors makes a given starting current supplied to an elevator motor much less serious than when supplied to the ordinary squirrel-cage motor.

Rehabilitation in Philadelphia.

The rehabilitation of the Philadelphia Rapid Transit Company, as agreed upon by the directors in return for the $10,000,000 guaranteed by the Union Traction Company, calls for the assignment and transfer to the Union Traction Company of all the interest and equity of the rapid transit company in the Market Street elevated and subway system, Darby & Yeadon Street Railway Company, Doylestown & Willowgrove Railway Company, and all other railway properties acquired by the Company since July 1, 1902, when the Philadelphia Rapid Transit Company leased the street railway lines of the city from the Union Traction Company.

In order to carry these financial plans the stockholders of the Transit Company will be asked to authorize an increase in the indebtedness of the Company from $5,000,000 to $15,000,000 on February 28.

SEWAGE PUMPING IN NEW ORLEANS.

ELECTRICALLY DRIVEN PUMPS USED EXTENSIVELY.

For the purpose of collecting data relative to the installation of efficient sewage-pumping stations in Greater New York, Assistant Engineer John E. Hill visited and reported upon the pumping plants at New Orleans, La., and the following report submitted by Mr. Hill upon his return forms an interesting commentary on the advantages and efficiency of electric pumping:

New Orleans being built on very flat ground, with the highest elevations at the mandatory points of outfall, it is impracticable to install any sewerage system which will deliver the sewage flow of all sections of the city to the necessary points of outfall by uninterrupted gravity. Consequently, automatic pumping stations, electrically connected with central stations, have been designed along the lines of the main interceptors and their principal tributaries. Of the thirteen designed automatic sewage pumping stations, but six are at present built, of which four, Nos. 1, 6, 8 and 9 are primary low-lifts and two, Nos. 14 and 15 are intermediate low-lifts; the principal elements of these six stations are shown in the following table:

Station.	Size of pump (in inches)	Capacity of pump in cubic feet per minute	Total head (feet)	Diameter of Inlet Sewer (inches)	Diameter of Outlet Sewer in inches)	No. of Pumps
1	8	210	7	27	27	1
6	8	170	6	24	24	1
8	8	170	8.4	24	24	1
9	8	270	8.6	30	30	1
14	15	710	8.4	54	53	2
15	12	450	13	33	24	2

The pumps are all centrifugal pumps directly and vertically connected to induction motors, and all friction bearings and working parts are submerged in oil. An ultimate installation of three units at the primary stations and of four units at the intermediate stations is planned. Each inlet sewer discharges into a shallow suction pit having extended vertical walls.

All these six substations are built of reinforced concrete and have their pumps set in a dry well with the center of the pump casing below the level of the center line of the inlet sewer. They are provided with automatic regulating

devices connected with float-chambers and so arranged that the pumps will go into operation at their full-rated capacity when the inlet sewer is seven-tenths full, and will cease when that sewer has been pumped dry at the suction-pit end. They are also provided with secondary float-chambers and cable devices used for automatically sounding signal alarms at the central station. Each chamber is connected with the primary duct, and, when the water in the sewer rises above the seven-tenths full level, lugs on the cable throw a connecting arm into the circuit and a continuous alarm is rung and an annunciator falls at the central station. An emergency by-pass leading from the suction pit to the discharge sewer is also provided and this comes into operation when severe storms flood the streets and surcharge the sewers, or when a sudden breakage either to machinery or to cable, or when a prolonged suspension of power renders the plant for a time inoperative.

Besides these installations, each station is provided with a set of incandescent lights, a ventilating fan, an automatic gauge for recording sewage height, a transformer, a switchboard, a hydraulic-siphon sump pump and a compound inlet-outlet ventilating stack with hooded cowl. The lights, the ventilating fans and the pressure pumps operate to keep the stations dry, warm and fit for electrical apparatus. They have been found necessary, even though such apparatus is well incased and protected. The transformer reduces the main 3,000-volt line potential to the designed 220-volt motor potential. The switchboards are provided with the necessary switches, meters, safety-plugs and short-circuit alarms.

All of these substations are connected with the central station by armored and insulated triple-conductor power transmission and telephonic-signal cables carried in ducts laid on the sewer crowns; the length of each set of cables is about 12.3 miles. The intermediate stations are provided with superstructures, while the primary stations are entirely underground.

My general impression is that these stations at New Orleans do, undoubtedly, work efficiently and reliably and with perfect automatism, month in and month out. And I see no reason why they should not work practically as well in New York.

Flame-Proof Motors for Colliery Work.

The increasing use of electricity for one purpose or another in collieries is one of the outstanding features of the remarkable electrical development of the last few years. Of the many conditions which have to be kept in view some apply equally to apparatus designed for other work; but mining, or more particularly colliery, apparatus has frequently to be suitable for installation in fiery atmospheres, a condition which, in general, has no parallel in other services. Considerations turning on the use of apparatus in fiery atmospheres have more direct application to switch the fuse boxes and to motors, than to other types of apparatus, and much attention has been paid to the development of satisfactory designs in these special classes of plant. In general, two methods of construction suggest themselves for so-called flame-proof apparatus—that is, apparatus so designed that, if used in a fiery atmosphere, an internal explosion in the apparatus will not ignite an inflammable atmosphere which may be surrounding it. The first method depends on the use of gauze screens corresponding to those of a Davy lamp; while the second relies on the provision of long joints, frequently more or less tortuous, through which a flame projected from the interior of the apparatus is unable to make its way, owing to the cooling action of the metal of which the joint is made up. In principle these two methods of construction are the same, and in both cases depend upon the inability of a flame to pass through small or narrow passages surrounded by relatively cool metal; but the second would appear to possess advantages over the former in respect to ability to withstand internal explosions. With any type of construction there is always the possibility of the accumulation of an internal charge of explosive mixture, and the long-joint system allows the apparatus to be made of adequate strength, and yet retain the necessary comunication with the outer atmosphere to allow the products of internal firing to escape, ensuring, however, that they shall be sufficiently cooled during their passage through the joint to prevent any communication of flame to the surrounding atmosphere.

A flame-proof motor, constructed on the long-joint principle, is being introduced by the Phoenix Dynamo Manufacturing Company. In it the long-joint form of construction has been consistently adhered to throughout, while the bearings, which are of the roller or ball type, without oil-chambers or passages, are placed outside, and have no direct communication with the interior of the motor. Where the shaft passes through the case, cooling glands are fitted which fulfill the same purpose as the long-joints in other parts of the design. In the construction of the motor, the special requirements of colliery work have been kept always in view, and large clearances between live parts and the casing, and specially impregnated windings are features of the design. The question of accessibility for examination and adjustment has also received much attention. The motor has been tested at the maker's works by placing it in a chamber containing a mixed atmosphere of gas and air proportioned to give the maximum explosion on firing, care being taken that the atmosphere inside the motor casing was similar to that outside. The internal mixture was ignited by means of a sparking-plug. In all cases the internal firing failed to explode the outer atmosphere, which was afterwards fired by means of a second sparking-plug, as a check on the experiment.

Electricity in Coal Mines.

It appears, from a note in the *Electrical Engineer*, that Dr. Thornton, Professor of Electrical Engineering at the Armstrong College, Newcastle-on-Tyne, has, as a result of his visit to the Pretoria Mine at Hulton (Eng.) immediately after the recent disaster, made a non-electrical but thoroughly practical suggestion likely to have a very direct bearing on the use of electricity in coal mines. As the result of repeated experiments under varied conditions, he proposes that coal mines should be periodically sprinkled with a mixture of soap and water. If water is used alone, the coal dust soon becomes dry, and is then just as easily raised as ever, and quite as inflammable; but if a small quantity of soap is added, the coagulating effect has considerable permanency, and thus a coal mine so sprinkled is rendered much safer. If the Professor's idea can be brought to a practical issue, one of the most frequent arguments against the wider use of electricity in coal mines would be removed.

SPARKING OF MOTOR BRUSHES.—What is the quickest and safest way to stop the sparking on a direct-current motor while running?—W. F. V., New York.

There are many causes of sparking of motor brushes, some of which cannot be removed without first stopping the motor. Two possible sources of trouble can be remedied, however, without shutting down. The first is a dirty commutator. This should be looked for first. A medium sandpaper held on a flat block of wood should be applied to the commutator until it is uniformly bright. This usually at least diminishes the sparking. The second cause is wrong position of the brushes. The brush gear should be carefully shifted backward and forward through a moderate angle to see if some position cannot be formed in which the sparking is a minimum or entirely disappears. If both these efforts fail to produce any markedly appreciable effect, it is possible that one of the brushes has become loosened in its holder or shifted its position slightly so it does not set firmly against the commutator. If the attendant is properly insulated, he can remedy this, particularly when there is more than one positive and one negative brush. It is also worth while noting whether the motor is carrying a prolonged heavy overload and whether it is not provided with excessively heavy fuses to permit this state of affairs. If all these expedients fail, the machine will have to be shut down to permit a careful examination of the condition of the commutator and of each of the brushes.

TRANSFORMERS, INDUCTANCES, CONDENSERS.—(1) What is the difference in degrees of lag between the primary and secondary currents in a transformer? Is the difference in lag greater or less in an open-core transformer? Do all transformers have the same degree of lag? (2) How can one regulate inductive resistance to make the current lag any definite number of degrees? (3) Does a condenser in parallel with a circuit make the current a leading one to any great extent? About what extent can it be made to lead?—H. J. D., Chicago.

In general the primary and secondary currents of a transformer are nearly in opposition or have a phase difference of close to 180 degrees. This phase angle or lag depends somewhat on the nature of the secondary load. If this is highly inductive so that the power-factor of the secondary is less than that of the primary, then the lag between the primary and secondary currents is greater than 180 degrees; if the secondary load is noninductive or consists of apparatus that produces a leading current, with respect to the secondary voltage, or that gives a higher secondary than primary power-factor, then the lag between the primary and secondary currents is less than 180 degrees. On account of the large magnetizing current required by open-core transformers and induction coils, the lag between the resultant primary and secondary currents is usually less than in closed-magnetic-circuit transformers. (2) The inductance of an electric circuit can be varied at will by providing it with a more or less perfect magnetic circuit or by varying the number of turns on a coiled part of the circuit; the former method has the effect of varying the inductance without affecting the ohmic resistance. If the inductance is to be increased so as to produce a lag of nearly ninety degrees, the coil should be equipped with an iron core and the ends of the core connected by an iron yoke. (3) The current taken by a condenser leads the impressed electromotive force by ninety degrees. The effect of this current on the lag of the resultant or combined line current depends on how completely it neutralizes the "wattless" reactive component of the circuit in parallel with the condenser; if it just neutralized this component, it would bring the line current to unity power-factor; if it greatly exceeded this, it would produce a marked leading current, which probably would require a very large condenser and therefore make it extremely difficult to approach more than within a few degrees of ninety degrees lead. On a power circuit rotary condensers (synchronous motors with over-excited fields) are now often used to reduce the lag to nearly zero and in some cases to produce a few degrees lead.

CALCULATING POWER ON A MIXED SYSTEM.—How can the power factor be calculated on a system having a number of induction motors of different power factors along with arc lamps and incandescents?—C. O. S., Los Angeles, Cal.

This is a difficult problem unless the power factor and normal current of each branch of the circuit is known. The quickest solution is obtained graphically on the principle of vector addition. Assume a horizontal base line to represent the voltage axis. From a point at the left end thereof draw a line to scale representing the current of the first motor and making an angle with the horizontal equal to the axle whose cosine is the power factor of the motor. At the end of this line draw another to the same scale for the current of the next motor and again making with any horizontal an angle determined by its power factor. This is continued for each of the motors and arc lamps. For the incandescent lamps unity power factor may be assumed, that is, the vector line may be continued as a line parallel to the horizontal axis and of a length to scale representing the total incandescent-lamp current. From the extreme end of this line a line is drawn to the origin and the cosine of the angle it makes with the horizontal axis is the resultant power factor of the circuit. While this may seem a tedious process with a circuit having many parallel branches, it is the quickest one giving anything like the true result sought.

FUSING OF NEUTRAL WIRES.—Is it necessary to put a fuse in the neutral line of a 220-110-volt, three-wire, direct-current system when both outer lines are provided with fuses?—D. O. B., Milwaukee, Wis.

According to the National Electrical Code it is not necessary to fuse the neutral of such a three-wire line, provided that the neutral is of equal carrying capacity to the larger of the outside wires and is thoroughly grounded.

BOOK REVIEWS.

"Principles of Electrical Engineering." By Harold Pender. New York: McGraw-Hill Book Company. Cloth, 340 pages (6 by 9 inches), illustrated. Supplied by the Electrical Review Publishing Company for $4.00.

This book is written as an introduction to the subject of electrical engineering and deals exclusively with a study of the principles of electricity and magnetism and their applications in some of the simpler forms of electric apparatus and machines. The treatment of the subject is based upon the author's theory that the performance of various kinds of electric apparatus and various magnetic and electrical effects that come under the observation of the electrical engineer can all be explained in terms of a comparatively few fundamental principles or natural laws. The opening chapters of the book are, therefore, devoted to an analysis of these fundamentals. In stating these fundamental laws and in passing from them to the individual phenomena, the use of mathematics has been extensively employed to reduce the mental effort required. Following a treatment of the fundamental principles, the author discusses the subjects of magnetism, continuous electric currents, electromagnetism, electrostatics, variable currents, alternating currents and the symbolic method of treating alternating currents. Each is treated in a manner as thorough as the limited amount of space permits.

"Machinists' and Draftsmen's Handbook." By Peder Lobben. New York: D. Van Nostrand Company. Cloth, 487 pages (5 by 8 inches), illustrated. Supplied by the Electrical Review Publishing Company for $2.50.

This book contains a vast amount of data which should prove of value to all interested in mechanical work, especially machinists and draftsmen. The book contains the usual tables, rules and formulas with numerous examples, explaining the principles of mathematics and mechanics as applied to the mechanical trades. This is the second edition of the book and it has been somewhat enlarged and revised.

"Engineering Mathematics." By Charles P. Steinmetz. New York: McGraw-Hill Book Company. Cloth, 292 pages (6 by 9.5 inches), illustrated. Supplied by the Electrical Review Publishing Company for $3.00.

This work which embodies the subject matter of a lecture course given to the junior and senior electrical engineering students of Union University is intended as a supplementary to the general college course of mathematics, or to the general knowledge of mathematics which every engineer should possess. In illustrating the mathematical discussion, practical examples, usually taken from the field of electrical engineering, have been given and discussed. These are sufficiently numerous that any example dealing with a phenomena with which the reader is not yet familiar may be omitted and taken up at a later time. As appendix is given a descriptive outline of the introduction to the theory of functions, since the electrical engineer should be familiar with the general relations between the different functions which he meets. In relation to the books by Dr. Steinmetz on "Theoretical Elements of Electrical Engineering," "Theory and Calculation of Alternating-Current Phenomena," and "Theory and Calculation of Transient Phenomena," the present work is intended as an introduction and explanation of the mathematical side, and the author deems it the proper starting point of the study of the entire set.

"Storage Battery Engineering." By Lamar Lyndon. Cloth, 600 pages (6 by 9 inches), illustrated. Supplied by the Electrical Review Publishing Company for $4.00.

The first edition of this book appeared twenty years ago. During these years many changes have been incorporated in storage-battery practice, new forms of electrodes and auxiliaries have been devised, and a number of once familiar plates and apparatus have passed into the obscurity of the discarded and superseded. Equally marked is the improvement in the general understanding of this branch of engineering on the part of engineers and operators of plants. Therefore the present third edition has been completely rewritten. The present treatise not only considers the practical features of the art as it exists today, but considerably more of the theoretical side is included. Examples are the chapters treating electrolytic dissociation, the thermodynamical theory of the lead cell, and the fuller discussions in each of the other chapters in the first half of the book. These chapters may, however, be omitted in the reading, without the text becoming broken or disconnected. The discussion of the principal types of pole-wound boosters is retained in this edition, owing to the large number of these still in use.

"Insulating Substances" (Les Substances Isolantes). By Jean Escard. Paris: The Gauthier-Villars Library. Paper, 304 pages (5.5 by 10 inches), illustrated.

This publication considers the problem of selection of materials for insulators of different types and goes into the requirements of insulating material. The variation of the resistance of solids with different temperatures and the effect of impurities on the insulation value is taken up. Fluids and gas are treated in somewhat the same manner. Of a rather more practical nature are the chapters on insulators of porcelain, glass, cellulose compounds, rubber, etc. It was the aim of the author to produce a work, not of the dry and strictly technical variety, but one which would be interesting and at the same time guide those following this line of investigation. In this he has succeeded very well. The book has a large number of illustrations showing various types of insulators and curves are used in many cases to elucidate the variations of resistance under changing conditions.

"The Principles of Electric Wave Telegraphy and Telephony." By J. A. Fleming. New York: Longmans, Green & Company. Cloth, 906 pages (6.5 by 8.5 inches), illustrated. Supplied by the Electrical Review Publishing Company for $7.50.

In preparing the second edition of this work extensive additions have been made to bring it up to date and much of the original matter has been revised and rewritten. The treatment of the purely historical side has been, as far as possible, restricted. The present treatise is based to a large extent upon the subject-matter of a series of lectures delivered by the author on radiotelegraphy. There have also been added chapters on radiotelephony. The book deals chiefly with the scientific principles underlying the art, the theory of the operation of the instruments employed and especially with the quantitative aspect of the subject and the methods of measurement which are used in a metrical estimation of the quantities and effects concerned.

A fatal collision occurred recently on a French railroad, followed by fire due to the use of gas for lighting the cars.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

PACIFIC TELEPHONE & TELEGRAPH.

The Pacific Telephone & Telegraph Company has issued its report for the year ended December 31, 1910. The income account compares as follows:

	1910	1909
Gross revenue	$14,667,112	$12,885,018
Operating expenses, maintenance, taxes, etc.	†11,791,691	†11,641,489
Net revenue	2,875,413	1,243,529
Interest	1,676,208	.....
Balance	1,199,205	1,243,529
Preferred dividends	1,080,000	1,080,000
Surplus	*19,205	163,529

*Equal to 0.66 per cent earned on $18,000,000 common stock, compared with 0.91 per cent earned on same stock last year.
†Includes repairs $2,035,380, depreciation of plant $2,604,500, and taxes $416,586.
‡Includes interest charges.
The total expenditure during the year on the plant and real estate was $8,277,616.

ONTARIO POWER & NIAGARA FALLS.

The Ontario Power Company of Niagara Falls, and the Ontario Transmission Company, Limited, report for the six months ending December 31, 1910, compares as follows:

	1910	1909
Gross earnings	$384,433	$316,697
Operating expenses	68,916	64,294
Net earnings	315,516	252,403
Other income	46,842	3,003
Total income	362,359	255,407
*Interest	301,752	163,439
Surplus	60,606	91,967

*Of a total authorized issue of $3,000,000 debentures, $2,000,000 have placed their coupons maturing from July 1, 1910, to July 1, 1912, in trust, with an agreement not to present them for payment unless the interest has been earned. The interest due July 1, 1910, and January 1, 1911, on the entire issue of debentures having been earned, the coupons for the two dates just named have been presented and paid.

UNITED ELECTRIC SECURITIES COMPANY.

The report of the United Electric Securities Company for the eleven months ended December 31, 1910, compares with the year ended Jan. 31, 1910, as follows:

	†1910	1909
Gross income	$ 336,869	$ 367,515
Expenses and interest	222,513	246,139
Net income	114,356	121,376
Previous surplus	1,314,719	1,265,063
Profit sale	70,018	228,782
Total surplus	1,499,093	1,615,221
Dividends	195,000	195,000
Balance	1,304,093	1,420,221
Adj. (credit)	25,100	*105,502
Profit and loss surplus	1,329,193	1,314,719

*Debit. †11 months.

LONDON UNDERGROUND ELECTRIC.

The London Electric Railway Company has issued its report for the six months ended December 31, 1910. The income account compares as follows (figures for the corresponding six months of last year are the figures of the Great Northern, Piccadilly & Brompton, Baker Street & Waterloo and Charing Cross, Euston & Hampstead Railways consolidated):

Gross	£352,895	£346,058
Expenses and taxes	166,968	171,075
Net	185,927	174,983
Other income	5,166	5,025
Total income	191,093	180,008
Interest on debenture rents, etc.	89,638	87,102
Surplus	101,455	92,906

MASSACHUSETTS LIGHTING COMPANIES.

The report of the Massachusetts Lighting Companies for the year ended December 31, 1910, compares as follows:

	1910	1909
Total income	$1,166,608	$840,646
Expenses	759,032	540,108
Net earnings	407,576	300,537
Charges	96,177	74,109
Net profits	311,398	226,428

SOUTHERN NEW ENGLAND TELEPHONE.

The Southern New England Telephone Company reports for the year ended December 31, 1910, compares as follows:

	1910	1909
Gross	$2,706,012	$2,473,346
Expenses	2,148,667	1,926,944
Net	557,345	546,402
Dividends	461,622	461,622
Surplus	95,723	84,780

MACKAY COMPANIES.

The Mackay Companies have issued their pamphlet report for the year ended January 31, 1911. The income account compares as follows:

	1911	1910
†Income	*$4,125,907	$3,808,779
Preferred dividends	2,000,000	2,000,000
Common dividends	2,069,020	1,758,667
Operating expenses	37,194	32,335
Surplus	19,693	17,777

†Income from investments in other companies.
*Equal to 5.1 per cent on $41,380,400 common stock, after allowing four per cent on $50,000,000 preferred stock.

The report states that new transcontinental lines have been completed by construction from Reno, Nev., to Salt Lake City, Utah, and by construction from Seattle to Spokane, Wash. These lines enable the Postal Telegraph Company to give the best of service between the Pacific coast and the East. In the ocean system a new additional submarine cable has been laid from Waterville, Ireland, to Weston, England, with underground connection to London.

On the land-line system the night letter has been in use for eleven months. Much of the day business has passed into night letters—notably over one-half of that to and from the entire Pacific coast. The advantage to the telegraph companies is doubtful, to say the least. It necessitates the transmission of fifty words instead of ten, and transmission is expensive.

In February, 1907, the Postal Telegraph Company abolished free passes.

The report proceeds to state that no bonds, notes or stock have been issued and no debts incurred during the year and yet there has been substantial growth of the ocean and land-line systems. During the present year important extensions and improvements of the system will be made on land and sea.

AMONG THE CONTRACTORS AND SUPPLY MEN

JACOB E. FRY, Defiance, Ohio, has purchased the electrical supply house of E. J. Finn, of that city, and will continue his business.

ALSBURY BROTHERS, 216 North Sixth street, Springfield, Ill., is a new firm of electrical contractors which is featuring motors for general utility purposes.

ARNOLD & WETHERBEE, Oklahoma City, Okla, were awarded the contract for wiring the new public building at Oklahoma City. The contract price was $6,222.

E. S. ASBURY and J. A. SOLLIDER, of Beaumont, Tex., have purchased the business of the Southern Electric Company, 345 Forsythe Street, and are now running the business.

THE INTERNATIONAL ELECTRIC FIXTURE & CONTRACTING COMPANY, which recently incorporated at Duluth, Minn., with a capital of $10,000, will do a general electrical contracting business.

THE JACOB ELECTRIC COMPANY, Houston, Tex., has moved into larger quarters, and is now located at 616 Fannin street. The company does a general electrical contracting and supply business.

T. FRED LEE COMPANY, which was incorporated at Manhattan, N. Y., will do a general business in electrical supplies and appliances. T. F. Lee, of Brookline, Mass.; W. B. Johnson, New York City, and F. F. Green, of New Rochelle, are interested.

THE INDEPENDENT ELECTRICAL CONSTRUCTION COMPANY, Passaic, N. J., will engage in an electrical construction and installation business in Passaic. The authorized stock of the company is $10,000 and the incorporators are Harry Wilkie, Just Justenson and Christina Wilkie.

THE AVERY-LOEB COMPANY, Columbus, Ohio, received the contract for all the electrical work of the new Hartman Theater Building. The contract, which will represent an expenditure of almost $25,000, is the largest electrical contract yet let in Columbus. The lighting will be on an elaborate scale and the switchboard for the theater will be one of the largest used for this purpose in the state.

New Electrical and Mechanical Apparatus and Appliances.

Cement That Will Stand 3,000 Degrees Fahrenheit.

For many years, engineers have experienced great difficulty in proper maintenance of brick settings of furnaces of all types. They have been compelled to depend very largely upon the ordinary fire clay as a bonding material, and as this fuses at a comparatively low temperature, the bond between the bricks is rapidly destroyed and the result is that the cracks are opened up between the bricks, through which the gases of combustion enter, eventually weakening the brick and causing the walls to collapse. Every engineer realizes the annoyance and expense occasioned by occurrences of this kind.

Another feature which has been objectionable is the fact that refractory bricks become very porous on the surface and very soon the clinkers from the coals attach to the surface of the brick and in removing these with tools, the bricks are broken.

After several years devoted to research work on refractory cements to overcome these troubles, the H. W. Johns-Manville Company, New York, is now offering to the trade a line of cements called "J-M Refractory" cements for the following purposes: Furnace setting of various types, cupolas, lining brass furnaces, assayers' crucibles, oil-burning, tilting and rotary furnaces and for patching and facing bricks in place in the fire zone under various conditions. These cements are rated to resist temperatures as high as 3,000 degrees Fahrenheit.

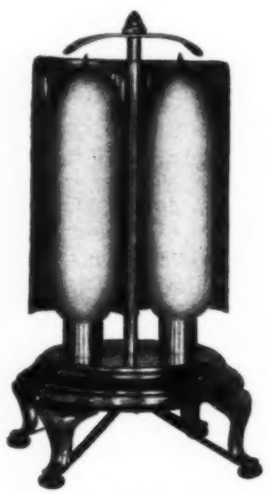
The company has also produced a coating for walls known as "J-M Brickline" cement, which prevents clinkers from adhering and to seal the pores of the brick.

Realizing that the conditions under which these cements are used are variable, they have been made capable of modification to meet conditions as they come up and the Johns-Manville Company invite the trade to place before them any conditions that are troublesome and they will be very glad to make a careful investigation and offer suggestions which will tend to overcome the difficulty.

Twin-Glower Electric Radiator.

Until it becomes customary to include special heating circuits in the wiring of our homes, the most successful heating devices will be those which are readily attachable to the lighting circuit in place of a lamp.

In the twin-glower electric radiator recently developed by the General Electric Company, the feature of ready applicability appears to have been given first consideration in that the heating elements are designed for a maximum energy consumption of 500 watts, thus permitting the operation of the radiator on any lighting circuit.



TWIN-GLOWER ELECTRIC RADIATOR.

It is noteworthy that in this case the feature of ready applicability has been obtained without sacrificing in the least the various well-known advantages of the luminous type of radiators. The same "non-oxygen consuming" radiant heat so essential to hygienic conditions not only in the sick rooms of homes and hospital wards, but also for safeguarding the general health of any household, is available, while extreme lightness of weight permits of the radiator being easily moved from room to room or to any other desired place. Thus it can be readily used for increasing the temperature of the bath room preparatory to the bath, for making the bed room comfortable in the early morning when the regular heating system has a low tone, and for adding to the comfort of reception halls, libraries, studies, and other rooms, which usually are of temporary occupancy. Furthermore, the absence of carbonic-acid-producing open flames renders its use particularly desirable in rooms containing valuable paintings and beautifully bound books, which rapidly deteriorate when exposed to injurious gases or products of combustion.

The campaign of education on the advantages of electrical household devices has been prosecuted so successfully that it is hardly necessary to repeat its many familiar and valid statements, yet any facts relative to the economy of these devices always are of vital interest to prospective users. In other words, they always like to know the price of a device and the cost of operation.

The price of the twin-glower electric radiator is only about a third more than that of the popular six-pound electric flat iron, and its cost of operation is about five cents an hour at the usual central-station charge for current. It is, therefore, within the reach of all who desire to avail themselves of many comforts which are unobtainable economically by any other means. Since these devices are only used for fractional parts of an hour, the monthly expense is comparatively small.

It is generally recognized that only a single trial is required for permanently establishing the electric flat iron, radiant toaster and disk stove as household necessities; likewise only one trial is all that is needed to add the twin-glower electric radiator to the popular trio.

The Advantages of Duplicate Batteries and Extra Trays.

An interesting case illustrative of the common, but too little appreciated electric-vehicle problem, is given herewith.

On April 25, 1910, the Balbach Smelting & Refining Company, Newark, N. J., installed a forty-four-cell, twenty-five plate Gould storage battery in its old five-ton General Vehicle electric. Up to the middle of February, 1911, when the inspector of

the Gould Company visited Veona, this battery had run every day except Saturdays and holidays without a single cleaning, repair or plate renewal. At that time the inspector showed that the sediment in the jars was only within five-eighths inch of the top of the bridges, but a cleaning was recommended as a general precaution. The Balbach Company, however, stated that it could not spare the vehicle from service for cleaning, and ordered an extra tray of cells to permit the cleaning of the battery at leisure, a tray at a time, leaving them afterward a perfect tray ready at all times for emergencies.

The above interesting incident suggests that in every case where a vehicle owner does not purchase one or more reserve batteries beyond the full number required by his vehicles, he shall purchase at least an extra tray of cells for the following reasons: (1) It permits thorough cleaning of the batteries at stated intervals, a tray at a time, with no delays or interference with service. (2) It permits the regular and frequent equalization of acid density and testing to be done during the days, instead of making a rush job of this work at night. (3) It is a cheap form of service insurance providing a reserve at all times in case of failure of a cell or tray from any cause. (4) It promotes the proper maintenance and care of batteries which are factors of inestimable importance in prolonged battery life. It is advised that an extra tray be purchased for at least every two batteries in service.

Supplementary to the above, it is urged that electric-vehicle owners do not lose sight of the fact that when it is possible for them to employ duplicate storage batteries so that they may exchange them at the main garage or convenient substation about the middle of the day's work; a freshly-charged battery for one discharged by the morning's work, the electric vehicle immediately becomes competitor of the gasoline truck for long-distance delivery and transfer work; service which it will perform with much greater reliability and considerably less cost than the latter.

Or, viewed from another angle, the relatively small increase in the investment of a duplicate battery doubles the earning capacity of the vehicle, which represents by far the greater proportion of the total investment.

In cases where duplicate batteries are used, convenience and time-economy recommend the under-slung type. By no means do all service conditions permit the use of duplicate batteries, but where they can be used, the greatest economy results from their employment.

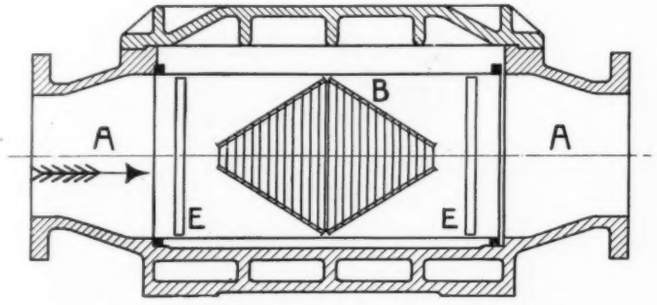


FIG. 1—DIAGRAMATIC VIEW OF THOMAS METER.

FIG. 2—EXTERIOR OF METER.

Westinghouse Equipment for South America.

The Rio de Janeiro Tramway Light & Power Company, of Rio de Janeiro, South America, has placed an order with the Westinghouse Electric & Manufacturing Company for two 2,500-kilovolt-ampere, 3,000-revolutions per minute, 6,300-volt, three-phase, fifty-cycle turbo-generators. The Westinghouse Machine Company will furnish the turbines, which will be equipped with No. 11 Leblanc condensers. This equipment will be placed in a new station which will operate in connection with the power company's water power station. The station will be located in the city and will be used only when the water is low.

A recent exploration of the Appalachian farming districts brought out the fact that there is as yet about 3,000,000 undeveloped horsepower in the streams of the South Appalachian region.

The Thomas Meter.

The Thomas meter is designed for measuring the rate of flow of gas or air. Its operation depends upon the principle of adding electrically a known quantity of heat to the gas and the rise in temperature between the inlet and outlet of the meter is then a measure of the amount of gas which has passed. Fig. 1 shows a section through the meter and Fig. 2 is an outside view. B is an electric heater so disposed in the gas passage as to impart heat to all of the gas passing through the pipe line of which the meter forms a part. The temperature of the gas is thus raised, the amount being measured and controlled by means of two electrical resistance thermometers shown at E. These are connected with an automatic regulating mechanism. The thermometers are in the form of screens of resistance wire so disposed as to come in contact with all the gas passing through the meter. Fig. 3 shows the construction very clearly. These resistances form two arms of a Wheatstone bridge, which, by means of the deflection of a galvanometer needle, causes the controlling mechanism to increase or decrease the electrical energy supplied, so that there is a definite change in the temperature of the gas. The watts input thus forms a measure of the quantity of flow of gas. The record of the flow is read directly from a watt-hour meter, or if desired, from the curve drawn by graphic wattmeters. The controlling device operates so as to change the power supply to the heater according to the difference in electrical resistance between the two thermometers. If this difference becomes greater than two degrees the controller operates a small rheostat so as to reduce the power supplied. If the rate of flow of gas is increased, the temperature difference is decreased, and at once additional power is supplied. It is said that

the accuracy of these meters is not affected by change in pressure or in temperature. Errors due to the presence of water vapor are eliminated by pre-heating. The meter is especially adapted for measuring the discharge of gas or air from compressors, blowers, etc. The power required to operate the meter is approximately one kilowatt for 75,000 cubic feet per hour at atmospheric pressure.

Some of the advantages claimed for this meter are as follows: there are no moving parts inside the meter, or in contact with the gas; the accuracy is independent of the rate of flow and the fluctuations of pressure and temperature; meters of comparatively small size have large capacity; the meter may be easily opened for inspection and for blowing out accumulated matter with an air blast or for washing with gasoline; the record of flow can be taken at any distance from the meter wherever it is most convenient to locate the switchboard and registering mechanism.

The Thomas Meter is manufactured by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. It was invented by Prof. Carl C. Thomas.

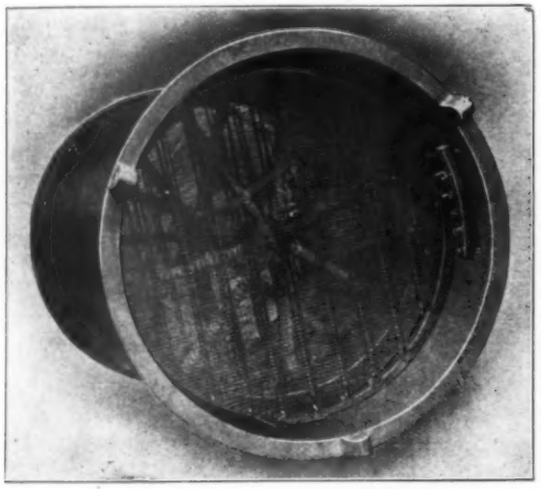


FIG. 3—METER CASING THROUGH WHICH GAS FLOWS.

Indiana Road Raises Pay.

Announcement has been made by the Chicago, South Bend & Northern Indiana Railway Company of a voluntary wage increase for its operating men and the recognition of a new principle in the gradation of pay and responsibility. The increase became effective March 1, and in some cases amounts to fifteen per cent.

NEW TELEPHONE APPARATUS.

NON-MULTIPLE TOLL SWITCHBOARDS.

The line of non-multiple toll switchboards offered by the Western Electric Company has been designed to handle conveniently, speedily and economically the toll service in either magneto or central-battery exchanges. These switchboards are built in two general types, namely, those having self-restored line signals and those having manually restored line signals. They are made in both single-position and double-position desk and cabinet patterns in various capacities, and are finished either in birch, with mahogany finish, or quarter-sawed oak, as desired. Simplicity, neatness and convenience are keynotes. Ample space for a calculagraph and sufficient room for the writing of toll tickets is provided.

Three-way keys in the cord circuits provide for the proper monitoring, two-way cut-off and two-way ringing features, which give the highest grade service and make the toll lines dividend payers. The lines terminate in either the well-known combined jack and signal or the manually restored drops. In the combined jack and signal the spherical target is directly associated with the jack. It is self- restoring and gives a positive signal to the operator, being easily seen from the side as well as the front of the board.

On account of their facilities for connections to the local board, these toll boards are said to have the highest operating efficiency. Features of these boards claimed by the manufacturers are: automatic incoming recording trunks, facilities for connection to plug-ended switching trunks, and facilities for switching toll lines to the local board at night. Provision is also made for through toll lines.

Horizontal-type keys are used in all these boards and all keys and jacks are platinum pointed. The well-known No. 116 cord weight, double cut-off jacks, the No. 25-A repeating coil and the Western Electric long-life tinsel cords are details which make for the success of these toll equipments.

This same line of switchboards is also especially adapted for use as magneto-exchange switchboards where a desk-type board is desired. They are especially attractive in appearance and so conveniently arranged that the operator can attend to other duties as well as take care of the switchboard.

TOLL BOARD WITH SELF-RESTORED LINE SIGNALS.

NEW MOISTURE-PROOF TELEPHONE CORDS.

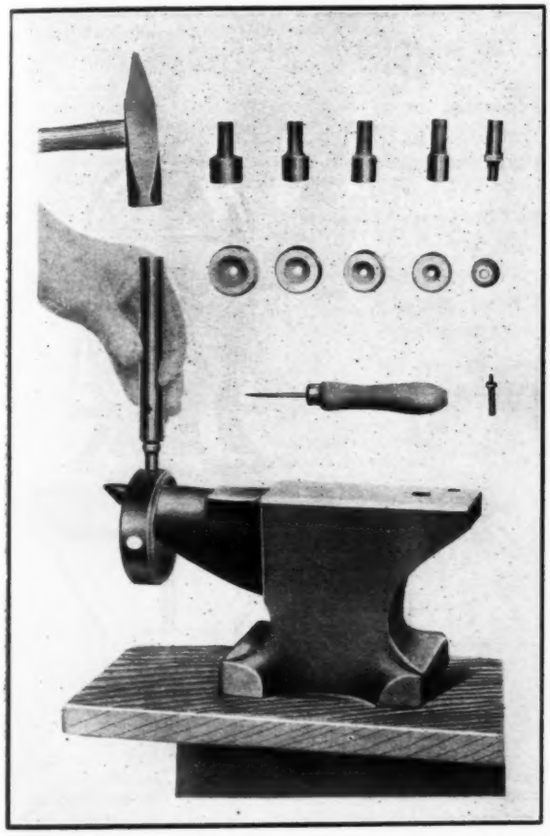
The Western Electric Company has recently developed a new line of telephone cords designed especially to meet the severe conditions common to railroad work. After a thorough test in the Company's laboratory a number of these cords were placed in actual service in order to insure their meeting the necessary service conditions. These tests, it is said, proved satisfactory and the cords are now giving excellent service.

The construction of these new cords is different from that of the standard cords now in use, the most radical change being that the insulation of each conductor is treated with

a moisture-proof compound and that each conductor, in those cords which are subject to the greatest wear, is reinforced with copper wires.

For example, each of the two conductors in the No. 408 receiver cord consists of a number of strands of the best tinsel reinforced with six strands of copper wire. The conductors are made up with an improved twist, and with the copper wires a great amount of strength is added to the cord. Each conductor is wrapped with a covering of wool, which has been saturated with a water-proof asphaltum solution. Over this is placed the conductor braid of mercerized cotton, and the entire cord is then inclosed in a special external braid of a high grade of mercerized cotton.

This construction insures a flexible, moisture-proof cord, with long life and increased strength throughout. These cords are made in standard length, consisting of one, two, three and four conductors for use as receiver, transmitter and extension cords in connection with the various types of desk stands, transmitter arms and flexiphones.



HAND PUNCH, ANVIL AND DIES FOR FIXTURE MANUFACTURES.

New Hand Punch and Die for Fixture Dealers.

To those who have followed the development of the electric and gas-lighting fixture industry it is obvious that for retail fixture dealers to purchase the shells, arms and parts of standard-design fixtures and assemble them in the various number of lights and styles as ordered by their customers, it is necessary to have an inexpensive punch and die for punching holes in the thin sheet-metal body bands and shells.

The Goshen Stamping & Brass Company, Goshen, Ind., has developed hammers, punches and dies guaranteed to do this work accurately and not injure the most delicate finish. These tools are designed to be used on a work bench and in connection with an anvil.

The center pin guide centers the punch in the die accurately, thereby greatly increasing the wearing qualities of the tool, and it is also used to seat the die on the anvil and remove chip from die. The anvil is built especially for this work and is furnished regularly in the twenty-pound size with the horn drilled to seat the body-band die.

The advantages claimed for this method of assembling fixtures are: cost of completed fixture reduced; fixtures can be made up from stock parts in any number of lights; a large assortment to select from for a given investment; all fixtures cut any length in the shop without waste, etc. The method of punching a hole in a body-band is shown in the accompanying illustration.

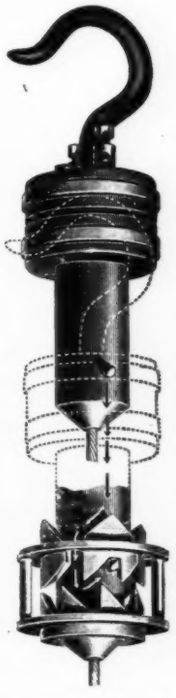


FIG. 1—MECHANISM OF LAMP HANGER.

Arc-Lamp Hanger and Lowering Gear.

The "one working part" arc lamp lowering gear is the name given a new arc-lamp hanger which is being manufactured by the London Electric Firm, Croydon, Eng. In Fig. 1 is shown the mechanism of this apparatus, which consists of an improved contact and suspension device, having one working part only and a self-sustaining winch.

The construction and action of the contact and suspension device is very simple. It consists of a plunger with two piston-ring contacts, and a pin engaging in a ratchet, to take the weight off of the rope. The device does not depend on the action of springs, levers, catches or clutch gear. It has no combustible material in its construction.

FIG. 2—ARC-LAMP HANGER FOR SERIES LAMPS.

Fig. 2 shows the Type F contact and suspension gear adapted for street-lighting arc lamps, where a separate cut-out in the lamp operates a substitutional resistance in the base of the pole. This device is also suitable for use with electroliers, enabling them to be easily lowered for cleaning and repairs.

The Long-Life Flaming Arc Lamp.

Long life in the carbons of flaming arc lamps has heretofore been obtained either by using a magazine of electrodes or by inclosing the arc in a double globe so as to exclude air and keep the inner globe hot enough to prevent the condensation upon it of the fumes from the impregnated carbons.

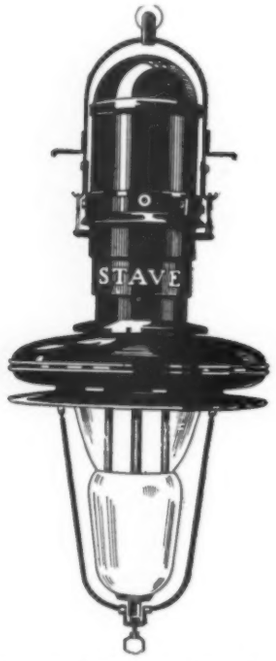
The Stave Electrical Company, 27 West Twenty-seventh Street, New York, N. Y., has recently put upon the market an inclosed flaming arc lamp which uses a single pair of carbons, but obtains a long burning life by means of a single globe so constructed as to obviate condensation in the useful light-transmitting part, at the same time that the air is excluded. This is secured by using a globe which at a short distance below the arc has a constricted portion. Above this constriction the globe is too hot to admit of condensation. The lower part of the globe is somewhat shielded by the constriction from the radiation and there is a rapid change in temperature near this point. The heavier products of combustion are consequently deposited in the base of the globe where they are not objectionable, whereas some of the lighter vapors are condensed in the space above the globe. This lamp is made in types burning from 100 to 200 hours and the main portion of the globe remains clear throughout. The smaller type of lamp is 32 inches in height and burns for 100 hours with a single pair of electrodes; the larger type is 37 inches long and burns from 150 to 200 hours. The upper electrode is five-eighths inch in diameter and the lower one one-half inch in diameter, both being ten inches long.

Not only is the necessity of frequent trimming obviated in these lamps, but the consumption of electrodes is very much reduced, thus bringing the cost of carbon renewals down to a very low figure.

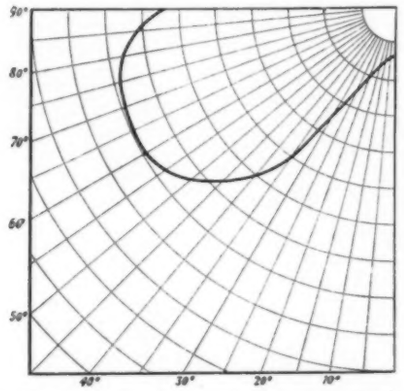
The lamps are built to burn two in series on a 110-volt circuit, the actual voltage around the arc being about forty-five volts. These lamps can be used on either constant-potential or constant-current circuits, taking either 10 or 6.6 amperes. The lamp which is rated at 2,000 candlepower consumes 330 watts, while the 3,000 candlepower lamp consumes 550 watts.

This lamp is used with alternating or direct current and the carbon is fed by means of a motor which produces a positive and steady feed and obviates flickering.

This lamp is particularly suitable for city illumination since it combines high efficiency with long carbon life. It is also well suited to factory lighting. The carbons are said to be very inexpensive. The distribution of light obtained with these lamps is shown in the accompanying illustration. The light given is a brilliant white or yellow and is very steady and very pleasing to the eye. Street lamps of this character require trimming only once a week, even in the winter months.



STAVE LONG-LIFE FLAMING ARC LAMP. 150-HOUR TYPE.



DISTRIBUTION OF LIGHT FROM STAVE LAMP.

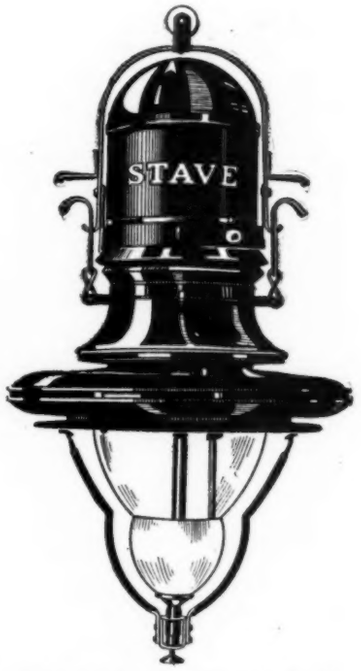
Silicon-Steel for Telephones.

Owing to the high resistance of silicon-steel, it is found that if the pole-pieces of telephone receivers are made up of this material in laminations, the eddy-current loss is greatly reduced, and only about one-half as much electrical energy is necessary to give sounds of the same loudness.

By making the diaphragm also of silicon-steel a further reduction of ten per cent in the necessary energy is achieved.

Wireless Between Trains.

There is being experimentally installed on the Stratford-on-Avon and Midland Junction Railway an apparatus invented by H. V. Kramer, of Birmingham, England, called the "Railophone," for which two important services are claimed. First, that it enables messages to be sent to and from a train, whether it is standing still or traveling at any rate of speed; and, secondly, that by automatically establishing communication between two trains on the same line it affords an additional safeguard against the danger of collision. As a safeguard against collisions between two trains on the same line within a zone of ten or five miles, a bell is rung on each train warning of the danger.



100-HOUR TYPE OF STAVE LAMP.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, FEBRUARY 18.—The London Electric Supply Companies have distinct cause for complaint at the manner in which they are being treated by the London Borough Councils in regard to street lighting. I have already mentioned the case of the Holborn Council, where the Electric Supply Company's tender for street lighting was rejected, summarily, in spite of the gas tender amounting to some $50,000 more on a ten-year contract. Another case has now arisen at Chelsea, where the Gas Company, obviously in order to avoid the risk of competition from the Electric Light Company, offered the Borough Council to cancel two and one-half years of the existing gas contract entered into at a high price when there was no competition from electricity, in return for a further seven-year contract at a lower price.

The Illuminating Engineering Society is doing good work in discussing the illumination of various classes of buildings, and the minimum requirements which may be stipulated. A discussion upon library lighting has just been completed, and one on school lighting has been inaugurated. From both these discussions there would seem to be a tendency to revert to low-voltage lamps. The opinion was expressed that to permit educationalists to make the best use of the recent invaluable advances in electric lighting, low-voltage supplies, i. e., not exceeding twenty-five volts, will have to be arranged, or else a sixteen-candlepower metal-filament lamp designed. To several people who have studied the subject, the more desirable aim is to reduce voltage, as this permits of the use of satisfactory reflectors of reasonable sizes and weight. It is a matter of great importance, as efficient reflectors are required for metal-filament lamps not only satisfactorily to distribute the light, but to reduce by contrast the high specific intensity of the filament.

A new Post Office telephone exchange is being built in the City of London with an equipment for 8,000 subscribers. There will be 3,000 keyless junction lines and some new features will be introduced in the multiples at the calling station.

The General Post Office Engineering Department is experimenting with a system of automatic telephones in its building in London, mainly with a view to testing the possibilities of such a system for more extended application. It is probable that before any general introduction of the system is decided upon, an experimental public exchange would be erected. G.

MEXICO.

(Special Correspondence.)

MEXICO CITY, MEX.—The Providencia Mining and Milling Company is installing electrical equipment for the operation of its new ore-reduction mill and cyanide plant near Guanajuato. The new installations will bring the electrical equipment of the company up to about forty motors with an aggregate of 600 horsepower.

The power plant of the Veta Colorado Mining and Milling Company near Panal, Chihuahua, has just been equipped with additional generators and motors, making it one of the largest and most modern of any mining company in Mexico. The company has also installed a complete lighting system. The initial electrical installation of the company comprised a 200-kilowatt generator, with exciter, switchboard, transformers, etc., in the generating station, two seventy-five-horsepower and a ten-horsepower hoisting motor, for hoisting at the mine, as well as six pump motors, two of 150-horsepower capacity, each for operating station pumps, and one forty horsepower motor, etc. The first generator is operated by a Hamilton-Corliss tandem, compound engine. Subsequently three additional 380-kilowatt generators were installed, with a corresponding number of exciters, switchboard and lighting protection apparatus.

This additional generator capacity was necessary to supply power for the large number of motors to operate the new mill and cyanide plant. In all over forty motors are used in connection with the milling and cyanide work, totalling about 1,000-horsepower capacity. This, in connection with the former electric equipment purchased for the mine, makes in all over fifty motors, totalling between 1,500 and 2,000 horsepower.

Moises Perogordo, of San Luis Potosi, with his associates, will construct an extensive system of long-distance telephone lines in that state. The proposed system will radiate out of this city to a number of towns.

The Monterey Telephone Company which operates the local telephone exchange at Monterey, will increase its capital stock from $250,000 to $500,000 for the purpose of greatly enlarging the system and making extensive improvements. D.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

POWER FROM CANALS.—The Minnesota Canal Power Company, which for ten years has been securing the right of way, flowage rights and other privileges necessary to the operation of its plant, is about to enter the head of the Great Lakes, and from it Superior and Duluth will receive power for the operation of their industries. The water will be secured from the St. Louis River above Cloquet. A canal will be constructed from Cloquet to the hill back of Ironton, ending in a flume which carries the water to the turbines in the plant. The turbines and generators of the Ironton plant are intended to have a capacity of 80,000 horsepower. The water will have a drop of 600 feet from the top of the hill to the power plant. A permit has been granted by the Government for the construction of the canals.

A NEW POWER CENTER.—The Georgia Power Company has secured sites and $10,000,000 in capital to furnish to Atlanta, Ga., and the surrounding territory 200,000 horsepower. The principal power plant will be at Tallulah Falls, at which place six generators, each capable of developing 15,000 horsepower, and other machinery will be installed. A gigantic dam 100 feet high will be erected, and from this the water will be tunneled for over a mile, in which manner a drop of 600 feet will be secured. The necessary plans are to be constructed within the next eighteen months, and the power will be ready for consumption by the summer of 1912. The developments by the Georgia Power Company will make Atlanta the greatest water power center, with the exception of Buffalo and its Niagara Falls, east of the Rocky Mountains. In addition to the plants at Tallulah Falls, the company has also secured sites at Gainsville and Franklin, in Heard and Cherokee Counties, and at other points which will furnish another 100,000 horsepower. The engineering work is in charge of C. O. Lenze, of New York, who is assisted by C. E. Parsons. I.

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

In the monthly report of the Public Commission Service, First District, it was announced that during January 127 formal complaints were made against the several street railroad lines of the various boroughs and against the Fifth Avenue Coach Company. Most of the practices complained against were remedied without necessitating the formulation of charges against the operating concerns.

Many matters of complaint are thus adjusted and important improvements made in the service of transportation, gas and electric companies in this manner without making demands upon the time of the complainant and defendant to attend hearings.

At the regular meeting of the Public Service Commission on February 21 the report on the testing of gas and electric meters for the month of January was submitted. During the month the Commission tested 34,816 gas meters, of which 567 were "complaint" meters, 7,918 new meters, and 26,331 repaired and removed meters.

The Commission also tested seventy-seven electric meters upon complaint, two of which were fast, four slow and seventy were both fast and slow.

The grand total of passengers carried by the Brooklyn extension of the subway since its opening in January, 1898, up to and including December, 1910, was given by the Commission as 82,211,798. The total traffic on the entire subway for the same period was 747,981,683.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

The Commission has authorized the Clifton Light and Power Company to issue $200,000 par value of bonds, to bear interest at the rate of six per cent per annum. These bonds are to be issued and sold for the purpose of supplying funds for the purchase of additional pole lines, right of way, real estate upon which to construct another dam in the town of Clifton, and other structures convenient in carrying on of its hydroelectric power business in the town of Clifton, the purchase of machinery and equipment, and paying outstanding indebtedness incurred by reason of additions and extensions to its property. A certificate granted to the same company August 31, 1910, authorizing the issue of $25,000 par value of bonds is cancelled in this order.

The Commission has authorized the Horicon Light and Power Company to issue $10,000 par value of bonds, bearing interest at the rate of six per cent per annum, and 100 shares of common stock of the par value of $100 each. The entire issue of stock and

bonds to the amount not to exceed $5,000 shall be issued to the Beaver Dam Light and Power Company in exchange for a transmission line constructed by it between Beaver Dam and Horicon, a substation and distribution system at Horicon. The balance of the bonds shall be sold for money only and at not less than eighty per cent of par value.

The Mt. Morris Farmers Telephone Company has been authorized to increase its rates and tolls from a flat rate of $1.00 per subscriber per month to the following classified rate schedule:

Single party business	$ 1.50 per month per subscriber.
Single party residence	1.25 per month per subscriber.
Party lines	1.00 per month per subscriber.
Rural subscribers	15.00 per year.

In computing the depreciation and interest and profit allowances in determining upon a basis for the rates given, the Commission figured depreciation on the whole system at six and one-half per cent per annum and interest and profit at seven per cent on the total investment.

The Richland Center Municipal Light and Water Plant has requested the Commission informally to investigate the situation in Richland Center and make a valuation of the utilities and recommend rates and regulations.

LIGHTING AND POWER.

(Special Correspondence.)

WYNNE, ARK.—This city will issue $50,000 in bonds to rebuild the electric light plant. P.

WAUKOMIS, OKLA.—The Waukomis Electric Light Company has been granted a franchise.

TOPPENISH, WASH.—The Valley Light and Power Company has extended the lines to Zillah.

NORTH BRANCH, MINN.—Mr. Sivak and others are organizing a $50,000 electric light company.

SNYDER, ARK.—This city has voted electric light and waterworks bonds to the amount of $40,000. P.

KIRKSVILLE, MO.—This city will vote on the issuance of $65,000 in bonds to construct an electric light plant. P.

BROWNSVILLE, TEX.—This city will vote March 14 on the issuance of $15,000 in bonds to extend the electric light system. P.

AYERVILLE, ILL.—The Peoria Gas & Electric Light Company has been awarded a contract to light the streets of the village for five years. Z.

ESMOND, S. D.—The contract for the installation of the electric apparatus at the light plant has been let to Howell Thompson, of Carthage, S. D. C.

BRAINERD, MINN.—The National Light, Heat & Power Company, of St. Paul, will carry out the franchise granted to the Toltz Engineering Company, of St. Paul. C.

WARSAW, IND.—The Winona Electric Light & Water Company is said to be contemplating improvements at its plant here. Theodore Frazer is general manager. Z.

MEDFORD, ORE.—It is believed that a light plant is soon to be erected at Eagle Point on the falls of Little Butte Creek. The proposition has been under consideration for some time.

MONMOUTH, ILL.—The Monmouth Public Service Company has purchased the plant of the Kirkwood Electric Company of this city. The original plant was erected at a cost of $12,000.

TOLONO, ILL.—The Chase Engine and Manufacturing Company of Mattoon has taken over the electric light plant here and is arranging to build lines to Sadorus, Pesotum, and Philo. Z.

ILO, IDAHO.—President Z. A. Johnson, of the Nez Perce Water & Power Company, has made application to the Council for a twenty-year franchise for electric lights and electric power.

WEBSTER CITY, IOWA.—The City Council is advertising for bids for a new fireproof electric light and power plant to cost, it is estimated, $40,000. The structure is to be completed August 1. Z.

ELGIN, ILL.—The property of the Elgin Merchants Lighting Company, bankrupt, has been sold to Walter Mills of Chicago for $37,950. The appraised value of the property was about $26,000.

MEDFORD, ORE.—Colonel Ray, of the Rogue River Electric Company has decided to install a plant at Prospect, Ore., within the next year. The new plant is planned to generate about 10,000 horsepower. A.

CLINTON, ILL.—A combined light and water plant to cost about $52,000 is being considered by the city at present. The city is now paying about $8,000 a year for light and repairs on its installation.

TURNER, ORE.—C. H. Cannon, local manager of the Balfour-Guthrie Company, Portland, Ore., has filed on water rights of Mill Creek, for power purposes. He plans to develop from 1,800 to 2,000 horsepower.

ARCOLA, ILL.—The Arcola Light Company has asked permission to erect a sample ornamental light, the business men having discussed a proposition to use the decorative system in the principal streets. Z.

EL PASO, TEX.—The Stone & Webster Company has been granted a contract to construct a $10,000 addition to the steel power plant building of the El Paso Electric Railway Company, on South Santa Fe Street.

WASHINGTON, IND.—The Citizens Light & Fuel Company has been incorporated with a capital stock of $75,000 to operate a light and fuel plant. The directors are: P. M. Taylor, Thomas Bururs and L. P. Boyle. Z.

GROVER, COLO.—A power company has made an offer to locate here and business men are pushing the proposition. It is proposed to furnish power for pumping plants for irrigation purposes and for electric lighting.

PORTLAND, ORE.—The Washington-Oregon Corporation has completed plans for taking over the plants of the Kalama Light & Power Company, the Rainier Light & Power Company and the Kelso Light & Power Company.

JOLIET, ILL.—The Illinois Valley Gas & Electric Company, of which Charles Munroe is general manager, has purchased the electric light plants at Mendota and Havana. A new plant will be erected at Havana where the Havana Electric Company recently secured a new franchise.

TROY, MONT.—J. H. Ehlers, of Spokane, Wash., has located a water-power site at Yakt Falls, where he will erect a plant capable of developing 5,000 horsepower. It is also planned to construct a line from the gold camp to a point on the Great Northern and a transmission line to the Sylvanite Mines. C.

OLEAN, N. Y.—The committee appointed by the mayor to investigate the cost of a municipal electric plant reported in favor of installing the lighting plant in connection with the municipal water plant. The committee favors the lighting of the city with 200 arc lights and 300 incandescent lights.

PORTLAND, ORE.—The Mount Hood Railway & Power Company will have its auxiliary steam power plant on the Peninsula entirely completed by April 1 and will be prepared a little later to give light and power service to the city. The plant is to cost about $100,000 and will develop 4,000 horsepower.

YONKERS, N. Y.—Application has been made for a charter incorporating the Citizens' Electric Light, Heat and Power Company, which plans to compete with the Yonkers Electric Light Company in the sale of current to merchants and residents of the city. The company is to have a capital stock of $100,000.

CHALCHUAPA, SALVADOR, CENTRAL AMERICA.—This place is to be lighted by electric machinery furnished by the Westinghouse Electric & Manufacturing Company. Power will be furnished by a 100-kilovolt-ampere, three-phase, sixty-cycle, 2,200-volt generator driven by a water turbine. Lighting is to be done with inclosed arc lamps.

JOLIET, ILL.—Rebuilding and extending the electric lines at Coal City, Braceville, Gardner, Streator, Ottawa, Sparland, Chillicothe, Dwight, Odell and other Illinois towns forms a good portion of the work called for in the appropriation of $500,000 which General Manager Charles A. Munroe of the Economy Light & Power Company announces the company will expend this year. Z.

MERCED, CAL.—The recent floods in River Canyon destroyed the power house of the Exchequer Mining & Power Company, with the result that the company is looking for another and more secure site for a new house on which work will begin as soon as the site is decided upon. F. S. O'Brien, manager and secretary of the company, states that the company is considering a site below the former one. A.

ESTACADA, ORE.—The Portland Water Power & Electric Transmission Company has recently ordered from the General Electric Company, a complete electrical equipment for its new power station located on the Clackamas River at River Mill Station, near this city. Three 3,300-kilowatt, sixty-cycle, three-phase, 11,000-volt generators will be direct-connected to three 600-horsepower hydraulic turbines, each generator being excited from a sixty-kilowatt direct-connected exciter. Each alternator will be connected to a three-phase step-up transformer of the same capacity as the alternator through disconnecting and oil switches. Each transformer will feed into the busbars or directly into the transmission line through oil and disconnecting switches at normally 57,100 volts "Y" for transmission of the power developed to Portland.

ELECTRIC RAILWAYS.

(Special Correspondence.)

BRYAN, TEX.—The Bryan-College Interurban Railway Company, which operates an electric line between the towns of Bryan and College, has been authorized by the State Railroad Commission to issue $72,000 of bonds upon its property. D.

CALUMET, MICH.—The Duluth-Superior Traction Company has made plans for the expenditure of $400,000 on its Superior-Duluth properties, at the head of the lakes. It will relay several miles of rails in Superior, Wis., and purchase more double truck cars.

EAST LIVERPOOL, O.—The Tri-State Railway & Electric Company has been incorporated with a capital stock of $10,000, by W. R. W. Griffin of the East Liverpool Traction & Light Company and four employees of that company. Its charter permits the

construction of an electric line between East Liverpool and Steubenville, O. H.

BRETTON WOODS, N. H.—Trains running up Mount Washington are to be equipped with electricity instead of steam, if the plans of the Boston & Maine Railroad just announced are carried out. A power plant to be located at the base of the mountain is to furnish electricity for the railroad and also for a searchlight which it is proposed to install at the summit.

CHARLOTTE, N. C.—The procuring of stock from local business men along the route of the Piedmont Interurban Railway, the North Carolina end of the 300-mile interurban electric line of the Duke interests, from Durham, N. C., to Greenville, S. C., is progressing rapidly, and Charlotte's share was all raised at an enthusiastic meeting of the Greater Charlotte Club and others recently. L.

FOSTORIA, O.—Construction work on the new Fostoria & Fremont electric line is fast nearing completion. The new extension will be over thirty-one miles long connecting with the Lake Shore Electric at Fremont, and the Toledo, Fostoria & Findlay, at Fostoria. It also makes connections with the Western Ohio at Findlay, giving through service from Cleveland to Dayton, where it connects with the Ohio Electric for Fort Wayne and Indianapolis. New limited cars with a seating capacity for sixty people are being built at Newark, especially for this service, to be delivered by April 1. The officers of the company are: President, F. D. Carpenter, Lima; vice-president, J. H. Goeke, Wapakoneta; secretary and treasurer, J. D. McDonel. H.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

HAYES, S. D.—The Homestead Telephone Company is putting in a new exchange. C.

TULARE, S. D.—The Western Farmers' Telephone Company has been incorporated with a capital stock of $5,000. P.

GETTYSBURG, S. D.—The Potter County Telephone Company has been incorporated with a capital stock of $50,000. P.

LE SUEUR, MINN.—The Farmers & Merchants Telephone Company has decided to build a direct line to Belle Plaine.

LEWISTON, MONT.—The Great Divide Telephone Company has been organized to construct a farmers' line south and west of here. C.

CHIPPEWA FALLS, WIS.—The Chippewa Falls Telephone Company is planning to extend its service for five or six blocks during the coming year. C.

FAIRMONT, MINN.—A new switchboard and other improvements will be secured for the local exchange. The president of the telephone company is R. P. Matson.

LELAND, IOWA.—The Thompson Telephone Company will handle the business of the Leland Company. The central at Leland will be cut off, and all connections will be made at Thompson.

LINCOLN, MINN.—The Southwest Lincoln Telephone Company elected the following officers for the ensuing year: A. A. Sheldon, president; Nels Stokkeboe, vice-president, and Carl Sabin, secretary.

WILLOW RIVER, MINN.—The Tribune Telephone Company has been incorporated with a capital stock of $25,000. The principal place of business will be Willow River. The incorporators are H. C. Sherrick, and two others, all of Willow River.

ELECTRICAL SECURITIES.

Of more importance than any other event was the decision of the Interstate Commerce Commission that the railways East and West are not entitled to the advances in freight rates they sought. Industrial interests are still awaiting the decision of the Supreme Court in the Standard Oil and American Tobacco cases. General business continues to be good and money is easy. Reports from the steel companies indicate improvement.

The Cities Service Company reports for the month of January: Gross, $94,455; net, $93,571. For the four months ended January 31, 1911: Gross, $349,830; net, $343,536.

The American Gas & Electric Company reports a surplus for the twelve months ended December 31 last of $412,509, as compared with $368,979 in the year previous.

At the annual meeting of the American Gas & Electric Company, F. P. Hunter was elected a director to succeed N. G. Kenan, resigned. Other directors were re-elected.

Commonwealth Edison's sharp advance brings the statement from President Insull that no important developments are pending, and that the strength is due to investment demand.

DIVIDENDS.

Chicago Telephone Company; quarterly dividend of two per cent, payable March 31.

New England Telephone Company; quarterly dividend of one and one-half per cent, payable March 31.

Columbus Railway Company; quarterly dividend of one and one-quarter per cent, payable March 1.

Detroit Edison Company; quarterly dividend of one and three-quarters per cent, payable April 15.

Galveston-Houston Electric Company; semi-annual dividend of $3 per share on the preferred and a dividend of $1.50 on the common, payable March 15 to stock of record March 1.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Feb. 27.	Feb. 20.
Allis-Chalmers common	8¼	8¼
Allis-Chalmers preferred	30⅜	31
Amalgamated Copper	63¼	65¼
American Tel. & Cable	*82	*82
American Tel. & Tel.	144⅜	146
Brooklyn Rapid Transit	77½	78¼
General Electric	152½	153
Interborough-Metropolitan common	18⅜	20
Interborough-Metropolitan preferred	52¼	54
Kings County Electric	123	123
Mackay Companies (Postal Telegraph and Cables) common	91¾	92½
Mackay Companies (Postal Telegraph and Cables) preferred	75⅞	75½
Manhattan Elevated	138	138
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	49½	52⅛
U. S. Steel common	77½	80⅞
U. S. Steel preferred	118⅜	119⅛
Western Union	73¾	73¾
Westinghouse common	69	70
Westinghouse preferred	118	*118

*Last price quoted

BOSTON.

	Feb. 27.	Feb. 20.
American Tel. & Tel.	144⅝	145⅝
Edison Elec. Illuminating	288	290¼
General Electric	152	153½
Massachusetts Electric common	16¾	17
Massachusetts Electric preferred	86½	87
New England Telephone	140	142
Western Tel. & Tel. common	20	20
Western Tel. & Tel. preferred	93	94

PHILADELPHIA.

	Feb. 27.	Feb. 20.
American Railways	44⅞	45
Electric Company of America	12¼	12⅛
Electric Storage Battery common	54	55
Electric Storage Battery preferred	54	55
Philadelphia Electric	16⅛	16¾
Philadelphia Rapid Transit	20	19¾
Philadelphia Traction	85¼	85
Union Traction	47¼	46¾

CHICAGO.

	Feb. 27.	Feb. 20.
Chicago Railways, Series 1	90	91½
Chicago Railways, Series 2	24	24½
Chicago Subway	120	4
Chicago Telephone	115	120
Commonwealth Edison	20½	116
Metropolitan Elevated common	...	20
Metropolitan Elevated preferred	65	65

PERSONAL MENTION.

MILTON MILL has been appointed Southwestern agent for the American Conduit & Manufacturing Company. Mr. Mill's address is 915 Olive Street, St. Louis, Mo.

J. H. SCHUMACHER, who has been connected for several years with Charles L. Pillsbury Company, has left that company to take up the management of the Mitchell-Gray Electric Company at Winnipeg, Man.

GEORGE A. JOHNSON of Los Angeles, Cal., announces that he has moved his office to 501 South Los Angeles Street where he will continue to act as sub-agent for motors, generators, transformers and instruments.

THEODORE B. HELLER of Carlisle & Company, sailed for England on the *Mauretania* to complete the organization of the London company which is acquiring the European patents of the Pay-as-you-enter Car Corporation.

R. S. SCARBURGH has become advertising manager of the New York Telephone Company, succeeding H. K. McCann, who recently assumed a similar position with the Standard Oil Company. Mr. Scarburgh was Mr. McCann's assistant.

GEORGE THORWARD, assistant manager and engineer of the South Bend Home Telephone Company for four years has severed his connection with the corporation. His resignation was filed with Elmer E. Daicey, general manager of the company, and became effective at once.

FRANK DEEBANKS, who has for the past three years been city electrician of Kankakee, Ill., is still retained in that position. Through wrong information it was stated in these columns that Jack C. Fisher had been appointed electrical inspector of Kankakee, but such is not the case.

ALONZO BURT, of Milwaukee, Wis., president of the Wisconsin Telephone Company, was a visitor to New York City last week. Mr. Burt states that there is a steady and strong increase in telephone subscribers in his territory, and that the demand for residence telephones is noticeably growing.

H. A. STRAUSS, vice-president and chief engineer of the Falkenau Electrical Construction Company, Chicago, Ill., has been appointed consulting engineer of the Merchants' Light & Power Company, of Ogden, Utah, to design a complete system for electric lighting and power for the city of Ogden.

CHARLES E. STAHL of Chicago, previously western representative for the Mosler spark plugs and accessories, has been

appointed western representative for the Connecticut Telephone & Electric Company, of Meriden, Conn. The Connecticut Company will open a branch office at Chicago with Mr. Stahl in charge.

FRANK K. SHUFF has severed his connection with the Iowa State College as assistant superintendent of fires, lights, and incidentals, to become superintendent of the Boone Electric Light & Street Railway and allied interests. The change took place on February 10, 1911. Personal mail should be addressed to Mr. Shuff at 509 Crawford Street, Boone, Iowa.

W. O. JOHNSON was recently appointed receiver for the Chicago & Milwaukee Electric Railroad by Judge Grosscup of the United States Circuit Court. Mr. Johnson is a director in the Western Trust & Savings Bank, of Chicago, and has had a considerable amount of experience in straightening out the financial difficulties of large corporations.

FRANK KOESTER, previously with the Interborough Rapid Transit (Subway) Construction Company, J. G. White & Company, the Guggenheim Exploration Company and the American Smelting & Refining Company, all of New York, recently opened an office at 115 Broadway, New York, as consulting engineer. Mr. Koester is author of "Steam Electric Power Plants" and "Hydroelectric Developments and Engineering."

HENRY FLOY, of New York City, recently purchased from the estate of William H. Bryan, of St. Louis, a complete reference file on the depreciation of engineering apparatus and structures. Mr. Bryan's standing as an engineer and his wide experience in making valuations and appraisals enabled him to make up one of the most complete collections of data relating to depreciation, and Mr. Floy is fortunate in having secured this valuable fund of information.

F. H. ENSIGN, of Phoenix, Ariz., has resigned as manager of the Pacific Gas & Electric Company of Arizona, after five and a half years of service. He has become identified with the New State Electric Supply & Fixture Company and the New State Auto Aerial Company, assuming the management of both these companies and at the same time retaining his position as consulting engineer with the Pacific Gas & Electric Company. R. G. Whitmarsh succeeds Mr. Ensign as manager of the Pacific Gas & Electric Company of Arizona.

GEORGE WESTINGHOUSE has accepted the invitation of the officials of the Southern Commercial Congress to address that body, and will speak before it on March 8, on the subject of "Electricity in the Development of the South." Although it has been fifty years since Mr. Westinghouse was a soldier in the Twelfth New York, and he has never traveled extensively in the South since that time, he is well informed on his subject. There has been a grat deal of interest shown along the line of Mr. Westinghouse's proposed address, and it is expected that he will speak before an enthusiastic audience.

M. S. ALLEN, who has been in charge of the Telephone Sales Department of the Western Electric Company's Atlanta house for three years, has been appointed manager of the Omaha house of the same company. Mr. Allen was connected with the Rocky Mountain Bell Telephone Company for ten years, entering the employ of the Western Electric Company as manager of its Salt Lake City branch in 1905. A year later he became manager of the San Francisco office, from which he was transferred to Atlanta in 1908. While in the south Mr. Allen has been closely identified with the enormous spread of the rural telephone movement in that section.

OBITUARY.

ISAAC McMICHAEL, vice-president of the Great Northwestern Telegraph Company, died in Baltimore, on February 22, following an operation for cancer. Mr. McMichael was born in Canada, and came to this country when seventeen years old. In the service of the Western Union Telegraph Company he worked his way up to the position of chief of a division and six years ago he was made vice-president of the Great Northwestern. Besides his widow and daughter, he is survived by one son, S. B. McMichael, of Toronto.

HENRY C. ROWELL, one of the oldest telegraphers in the country, died February 23 at his home in East Hanover, N. H., at the age of eighty-six years. He was connected with the telegraph department of the old Eastern Railroad and the Boston & Maine Railroad, retiring as superintendent of that branch of the service twelve years ago. A wife survives him.

LEGAL NOTES.

ASSUMPTION OF RISK AND DUTY IN PROMOTION FROM GROUNDMAN TO LINEMAN.—A person employed by a telephone company as a groundman, but advanced at increased wages to the work of a lineman, by accepting the promotion, assumes all risks ordinarily incident to his new duties and either known to him or obvious to a man of ordinary understanding; but if the new work involves unusual hazards, not obvious to a man of ordinary understanding or known to the employe, the company should exercise reasonable care and caution to instruct and warn him of those dangers.—Supreme Court of Nebraska, in Olson vs. Nebraska Telephone Company, 127 N. W., 916.

NO ILLEGAL DISCRIMINATION IN REQUIRING ADVANCE PAYMENT.—The Supreme Court of Tennessee holds that a suit was properly dismissed which was brought to recover a penalty from a telephone company upon the alleged ground that, having agreed to furnish the plaintiff a telephone in his home, the company declined to install it until he paid three months' rental in advance, which he declared was a "discrimination" against him inasmuch as the general rule of the company, under which the exaction was made, was not uniformly enforced against those seeking to become its patrons. The court notes that it is said that a railroad company has the right to require payment of freight charges by all of its customers in advance, or some of them, as it may think best.

POWER OF MUNICIPALITY TO FIX TIME OF PAYMENT OF TELEPHONE RATES.—Where a city ordinance provided that bills for telephone service should become due on the first day of the month following the rendition of the service and subjected the bills to a discount of ten per cent if payment was made on or before the tenth of the month following, the Court of Civil Appeals of Texas holds that this was reasonable. As to the contention that this would undoubtedly cause, in many instances, a loss, and that the company would have no means of protecting itself against such loss, if not permitted to discriminate as against its subscribers, the court says that the city is not called upon absolutely to guarantee a company against any and all loss. It is enough that, in the exercise of its discretion in making such rates, the company should not be subjected to a loss that was serious or unreasonable. But the court does not agree with the contention that the company is without discretion in supplying those who wish to become subscribers. To the contrary, it thinks the company under this ordinance might still prudently determine whom it would accept as a patron, and that no one who had refused to pay for its services and no one whom it might have just reason to suspect would not so pay would have the right to require further service from the company without proper security. Indeed, a provision in the ordinance that the company should furnish equal and uniform service alike to all citizens of the city and it should be unlawful to grant free service would make it obvious that it would be the duty of the company to refuse service to one who had refused to pay, or who had just reason to believe would not pay.—Southwestern Telegraph & Telephone Company vs. City of Dallas, 131 S. W. 80.

PROPOSALS.

PLANT EXTENSION.—B. Z. Mikkikan, City Clerk, will receive bids up to March 9 for furnishing material and labor for the extension of the electric light system. Separate bids will be received for furnishing generator, switchboard and 100-kilowatt steam turbine. A check for $200 must accompany the bid. C.

POWER MACHINERY.—W. D. Spence, City Clerk of Calgary, Alberta, will receive bids up to noon, March 22, for one 1,500-kilowatt generator; one 100-kilowatt exciter; three 1,000-kilovolt-ampere single-phase transformers. A check for two per cent of the amount of the bid must be sent. A vote will also be taken on issuing bonds for $50,000 for the erection of a power plant on the Elbow River. C.

POST OFFICE, PARIS, ILL.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until March 7 for the completion (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States post office at Paris, Ill., in accordance with drawings and specifications, copies of which may be obtained from the Superintendent of Construction at Paris, or at the Supervising Architect's office.

POST OFFICE, DES MOINES, IOWA.—The office of the Supervising Architect, Washington, D. C., will receive bids until March 14 for the roof over the driveway (including plumbing, gas piping, electric conduits and wiring), and lighting fixtures at the United State post office at Des Moines, Iowa, in accordance with the drawings and specification, copies of which may be had at the office of the custodian at Des Moines.

POWER EQUIPMENT, CLEVELAND, O.—The director of public service has been authorized to make the following expenditures: Electrical equipment of traveling crane at the Kirtland Street pumping station, a sum not exceeding $3,500; electric meters for the municipal lighting plant, a sum not exceeding $3,000; arc lamps for the municipal lighting plant, a sum not exceeding $800; transformers for the municipal lighting plant, a sum not exceeding $2,000; copper wire for the municipal lighting plant, a sum not exceeding $2,500.

NAVY DEPARTMENT SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on naval supplies on dates given below. Bidders interested therein should make early application for copies of the schedule, giving the schedule numbers desired. Schedules can be obtained from the Navy Pay Office nearest each navy yard. Bids will be asked on the following supplies:

Date of Opening.	Material.	Quantity.		Delivery at N. Yard.	Schedule No.
Mar. 14...	Switchboards, telephones, etc.	Miscellaneous.		Various	3376
	Terminals for single conductor	950		Brooklyn, N. Y.	3376
	Mica, uncut	75	pounds	Brooklyn, N. Y.	3376
	Voltmeters	3		Brooklyn, N. Y.	3376
Mar. 21...	Lathes, motor-driven	2		Norfolk, Va.	3367
Apr. 4....	Crane, electric	1		Mare Is., Cal.	3368

NEW INCORPORATIONS.

DEVILS LAKE, N. D.—The Duplex Multi Spark Plug Company has incorporated with a capital of $5,100. The incorporators are H. E. Maher, Clarence E. Beugess and J. R. Kollar.

TOLEDO, O.—The Lewis Electric Welding Manufacturing Company has been incorporated with a capital of $10,000 by G. L. Lewis, Frank W. Otis, A. Ewald Prener, W. W. Fraser and E. J. Marshall.

CHICAGO, ILL.—The Charles H. Debs Company has incorporated with a capital of $5,000 to manufacture gas and electric fixtures. The incorporators are Charles L. Cohns, Charles H. Debs and Joseph Rosenberg.

ST. LOUIS, MO.—The International Electric Fixture & Contracting Company has been incorporated with a capital of $10,000 by Robert Holmes, J. P. Lombard, R. H. Robinson. The company will deal in electrical machinery.

BUCHANAN, MICH.—The Electric Fireless Cookstove Company has incorporated with $14,000 capital to manufacture electric and cooking apparatus. Charles Bishop, Charles Fears, Clyde Baker and John W. Beistle, all of Buchanan ,are among the incorporators.

HARPERS FERRY, W. VA.—The Trackless Trolley Company of Maryland and West Virginia has incorporated with a capital stock of $100,000. The company proposes to put a line in operation in Martinsburg, W. Va., in the spring and this line will probably be extended to Winchester, Va. The incorporators are L. H. Downs, H. L. Kirby, A. D. Bowers, M. L. Montague and H. H. Emmert.

NEW YORK, N. Y.—A banking syndicate, composed of Goldman, Sachs & Company and Lehman Bros., of New York, and Kleinwort, Sons and Company, of London, have purchased $13,500,000 of the seven per cent cumulative preferred stock of a new company, to be known as the Studebaker Corporation, with $45,000,000 capital. The corporation will take over the wagon works of Studebaker Bros., at South Bend, Ind., and the automobile manufacturing plant at Detroit, Mich., of the E. M. F. Company.

NEW PUBLICATIONS.

AMERICAN SOCIETY FOR TESTING MATERIALS.—The Proceedings of the thirteenth annual meeting held at Atlantic City last June has been issued by the secretary. The few papers of electrical interest have been abstracted in our columns.

AN INVESTIGATION OF BUILT-UP COLUMNS UNDER LOAD.—This publication, prepared by Arthur N. Talbot and Herbert T. Moore, is issued as Bulletin No. 44 of the Engineering Experiment Station of the University of Illinois. The investigations were made on steel and wrought-iron built-up columns. Copies of the Bulletin may be had from W. F. M. Goss.

REQUIREMENTS OF NATIONAL BOARD OF FIRE UNDERWRITERS.—The National Fire Protection Association has prepared this book of requirements for the use of boards, bureaus and inspectors who must necessarily be familiar with those phases of electrical work connected with mill construction. The booklet covers standard mill construction, "Inferior" construction, general hazards, oil rooms, general protection, stairway and elevator closures, watchmen, thermostats and other matters.

ELECTRICAL EQUIPMENT IN COAL MINES.—The *Monthly Bulletin* of the American Mining Congress for January, 1911, contains the report of the Committee on Standardization of Electrical Equipment in Coal Mines. The report consists of a "Proposed Code of Rules for the Installation and Use of Electricity in Coal Mines." The code covers the following subjects: Definitions; General; Underground Stations and Transformer Rooms; Transmission Circuits and Conductors; Switches, Fuses and Circuit-Breakers; Motors; Electric Locomotives; Electric Lighting; Shot Firing by Electricity; Electric Signaling; Electric Relighting of Safety Lamps.

BULLETIN OF MISSISSIPPI ELECTRIC ASSOCIATION.—The convention reported was the second annual convention of the Association, and was held at Greenville, Miss., June 15 and 16, 1910. Papers read were: "Grounding of Alternating Secondaries," R. P. Strong; "The Modern Steam Engine," M. E. Griffin; "Depreciation," S. W. Greenland; "Depreciation of Lighting Plants," Jack Abbott; "Electrical Advertising," C. E. Varney; "Tungsten Lamps," A. H. Jones; "Uniform Rates," F. J. Duffy; "The Relation of the Meter to the Central Station," F. H. Mohns; "Recent Development and Applications of the Curtis Steam Turbine," Eskil Berg; "Public Policy," F. N. Lotterhos.

THE ELECTRICAL BRIDGE FOR THE DETERMINATION OF SOLUBLE SALTS IN SOILS.—The pamphlet describes the use of electrical methods for determining the soluble salt content of soils, with a view especially of finding the amount of alkali or harmful excess of soluble salts. The amount of current that will pass is of course increased with the amount of salt in solution and the conductance of the soil increases almost proportionately with the moisture content. The instrument, which is simply a modification of the Wheatstone bridge is described and a good many readings in the form of tables are reprinted. For the use of those who want to become familiar with the instrument, a full set of drawings has been prepared and is enclosed with the bulletin

INDUSTRIAL ITEMS.

H. B. CAMP COMPANY, New York, N. Y., advertises "Camp-Duct" on a recently mailed card.

THE ROESSLER & HASSLACHER CHEMICAL COMPANY, New York, N. Y., has issued its February catalog of chemicals.

THE EASTERN ELECTRIC LAMP COMPANY, Boston, Mass., is mailing cards and calendars advertising Eastern Mazda lamps.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., mentions its new catalog No. 8 in the February issue of *Trumbull Cheer*.

THE REYNOLDS ELECTRIC FLASHER COMPANY, Chicago, Ill., includes some diagrams and interesting data in Bulletin No. 6, which has recently been distributed to the trade.

THE RAIL JOINT COMPANY, New York, N. Y., moved its Chicago office on March 1, from its old quarters to the Railway Exchange Building. The office will be located in room No. 215.

THE RELIANCE ELECTRIC & ENGINEERING COMPANY, Cleveland, O., recently moved into its new plant and should now be addressed at Collinwood Station. This will insure the prompt receipt of mail.

THE AMERICAN CIRCULAR LOOM COMPANY, Boston, Mass., advertises its "X Duct" on a recently mailed card. This duct has a copper plating under the zinc coating, a combination which is said to be immune against corrosion.

W. N. MATTHEWS & BROTHER, St. Louis, Mo., have mailed to their customers and others interested a card advertising Matthews guy anchors. The card itself will be accepted by the company as payment for freight on a trial order of anchors.

THE GENERAL VEHICLE COMPANY, Long Island City, N. Y., includes an article on electric commercial vehicles in St. Louis in the February number of *Elec-Tricks*. Some of the trucks illustrated in this issue are provided with electric winches.

THE SANGAMO ELECTRIC COMPANY, Springfield, Ill., is distributing Bulletin No. 20, giving full description of its mercury flotation watthour meters. Considerable information is given on the theory of operation, methods of making adjustments, etc.

THE NATIONAL INDIA RUBBER COMPANY, Bristol, Conn., on March 1 opened a western office in the Peoples Gas Building, Chicago, Ill. P. F. Lyons, formerly western agent for the company has assumed the duties of manager of the western territory with headquarters at Chicago.

THE SOLDERALL COMPANY, 143 Liberty Street, New York, N. Y., is supplying dealers with "solderall" in collapsible tubes. It consists of finely pulverized solder combined with a special flux in a paste. Being non-corrosive, convenient to handle and always ready, it is coming into general favor.

THE PLATT IRON WORKS COMPANY, Dayton, O., has published three bulletins which will be sent on request to those interested. These publications are on the following subjects: "Smith-Vaile Boiler Feed Pumps"; "Smith-Vaile Air Compressors"; and "Victor-Francis Turbine Water Wheels."

THE GARVIN MACHINE COMPANY, New York, N. Y., has prepared a wall hanger giving a list of decimal equivalents for the use of engineers, manufacturers, architects, etc. The table is printed in large type so as to be legible at a considerable distance. These hangers will be mailed upon request to those interested.

THE PACIFIC ELECTRIC HEATING COMPANY, Ontario, Cal., advances a number of valuable suggestions, in the February number of *Hot Points*, for introducing heating appliances. A full-page advertisement, which is to appear in the *Saturday Evening Post* of March 11, has been reproduced in the issue for the benefit of Hotpoint salesmen and agents.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, O., reports a number of sales of motors and generators, among which were two fifty-horsepower induction motors and thirty-six smaller machines to Bishop & Babcock. The Triumph Company has found it necessary to work a night shift in order to produce the large amount of machinery ordered.

THE SIMPLEX ELECTRIC HEATING COMPANY, Cambridge, Mass., includes, in a recently published bulletin on electric heating, a number of good points relating to the cost of operating its electric heaters and the time which these devices save. There are a number of illustrations, each being accompanied by a description, with prices, specifications, etc. Besides the usual flatirons, chafing dishes and other small devices, there are also electric ranges, baking ovens and more expensive pieces of apparatus.

THE MORRIS IRON COMPANY, New York, N. Y., announces that its plant at Frederick, Md., is being greatly enlarged in order to meet demands occasioned by the spread of outdoor lighting throughout the country. The company's standard fixtures are also undergoing a radical development, especially where wooden poles are replaced by those of iron. When the altering new plant of the concern is finished it will be the largest one in the country equipped for the manufacture of ornamental lighting posts, poles, brackets and specialties.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has just issued sections 804, 805 and 806 of its detai'

catalog. The new sections describe the complete line of insulating materials recently placed upon the market by this company. The lines described include treated and untreated cloths and papers for insulating purposes, and insulating and soldering fluid, including shellacs, varnishes, soldering acids, soldering paste, glue, cement, etc. A catalog section has also been issued on type S and SA, distributing transformers which are designed for light and power service up to 3,800 volts.

THE SOUTHERN-WESCO SUPPLY COMPANY, Birmingham, Ala., announces an increase in stock from $30,000 to $50,000. At the same time John D. Turner, formerly of Atlanta, takes charge of the credit department of the company. Exceptionally good business is stated to be the reason of the stock increase. The present officers of the concern are: Oscar C. Turner, president; Rogers V. Scudder, vice-president; William M. Bowles, secretary, and J. D. Turner, Jr., secretary. To announce the recent changes to the local trade there has been a full-page advertisement published in one of the Birmingham papers.

PETTINGELL-ANDREWS COMPANY, Boston, Mass., includes in the February number of *Juice* an article on the modern illumination of interiors. Remarks of David Cromfield, the company's illuminating engineer and fixture designer, before the New England section of the Illuminating Engineering Society form the basis of the article. Notes on "Okonite" wires and cables and new shape of "Opalux" reflectors appear, as well as some account of the "S" series of condulets, Hartford time switches and Macbeth glassware. The seventh of the series of wiring tables is also published. For the convenience of the readers of *Juice*, an index covering the 1910 numbers has been mailed with the current issue.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., describes its 1911 electric fans in Bulletin No. 1126. The line is extremely well designed and contains bracket fans, desk fans, fans for telephone booths and fans of many other types. As the bulletin is printed on glazed paper and is illustrated with excellent half-tone engravings it makes an attractive as well as a valuable reference catalog. The company has also published bulletins on several other subjects, among which are: Bulletin No. 23, on single-phase prepayment induction wattmeter, type K^3; Bulletin No. 1120, on the type A electric rock drill; and Bulletin No. 1122 on small motors and their applications. This latter covers types SA, SD, GA and GD.

THE CENTRAL STATION DEVELOPMENT COMPANY, Cleveland, O., announces that a change has recently been made in its organization. Leonard J. Botting, secretary, has been appointed general manager succeeding W. H. Wissing, who will now concentrate his energies on the investigation of successful central-station methods. Mr. Wissing will thus have sufficient time at his disposal to enable him to place in the hands of the clients of the Central Station Development Company data pertaining to the results accomplished through the country. Mr. Botting's long association in central-station work, particularly qualifies him for the position of general manager of the company. He is rated very highly not only as a practical central-station operating man, but as a thoroughly competent engineer fully acquainted with all conditions of central-station operation.

THE VALENTINE-CLARK COMPANY, of 1001 McCormick Building, Chicago, announces that on March 15 it will remove its general offices to 932 Security Bank Building, Minneapolis, Minn. The company for twenty years has been identified in the cedar trade in Chicago, and recognizing that the successful operation of any business depends greatly on the producing end, are making this change in order that it may be in closer touch with its woods operations. As is generally known, cedar is practically cleaned out of Michigan and certain portions of Wisconsin, and in the future ninety per cent of the poles, ties and posts will be produced in upper Minnesota and in the West. Northern white-cedar poles will be carried in large quantities as usual at the Prentice and Green Bay, Wis., yards, the latter yard being particularly well located for eastern shipments.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has devoted Bulletin No. 4787 to the subject of wires and cables. Although no prices are given the bulletin contains a considerable amount of data. A revised bulletin No. 4791 superseding previous bulletin has been issued on "Feeder Voltage Regulators." The bulletin describes the company's regulators of the induction type and switch type, single and polyphase, hand operated and automatically operated. It contains connection and dimension diagrams, together with weights of the various regulators described. Bulletin No. 4811 describes drum controllers and supersedes the company's previous bulletins on this subject. In Bulletin No. 4812, are described small direct-current generators ranging in capacity from one and one fourth to twenty kilowatts, and suitable for lighting small plants, hotels, residences, factories, or mills, where the average length of the feeder circuits is 400 yards or less. The generators are provided with sliding bases which facilitate adjustment of the belt, and can be installed on the floor, wall, or ceiling. With the exception of the one-and-one-fourth-kilowatt generators, all of these are provided with commutating poles, so rendering a change in position of the brushes with change of load unnecessary. This bulletin contains table of ratings, weights and dimensions.

Bulletin No. 4813, describes an oil-break switch adapted to use on alternating-current series-arc systems for sectionalizing feeder systems, cutting in and out transformers, and similar classes of service requiring a switch to be operated under load.

DATES AHEAD.

Minnesota Electrical Association. Annual convention, St. Paul Hotel, St. Paul. Minn., March 14, 15 and 16.

National Electric Light Association. Annual meeting of New England Section, Edison Building, Boston, Mass., March 17.

West Virginia Independent Telephone Association. Annual convention, Waldo Hotel, Clarksburg, W. Va., March 23 and 24.

American Supply and Machinery Manufacturers' Association. Annual meeting, Louisville, Ky., April 3, 4 and 5.

American Electrochemical Society. Annual meeting, Chemists' Club Building, New York, N. Y., April 6, 7 and 8.

Missouri Electric Gas, Street Railway and Water Works Association. Annual meeting, St. Louis, Mo., April 13, 14 and 15.

Iowa Electrical Association. Annual meeting, Davenport, Iowa. April 19, 20 and 21.

Southwestern Electrical and Gas Association. Annual convention, Houston, Tex., April 27-29.

National Electric Light Association. Annual convention, New York City, May 29 to June 3.

Mississippi Electric Association. Annual convention, Gulfport, Miss., June 20-21.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) February 21, 1911.

984,534. MULTIPLE ELECTRIC-LIGHT SWITCH. Guy D. Brookins and John C. Vetter, Cleveland, Ohio, assignors of one-third to Clarence H. Collings, Cleveland, Ohio. Filed April 21, 1910. A rotatable circular switch member carries an arc-shaped contact plate adapted to contact with any number of radially placed contacts for multiple circuits.

984,536. ELECTRIC-LIGHT FIXTURE. Pincus Burger, New York, N. Y. Filed Dec. 23, 1910. Comprises means for attaching shade holder to a lamp socket and centering it.

984,538. EDGE SETTER AND FINISHER. Edwin N. Chandler, Brockton, Mass., assignor to Simplex Electric Heating Co., Boston, Mass. Filed Aug. 11, 1910. Comprises an edge-setting tool, a carrier block therefor mounted for vibration, and an electric resistance device for heating the block.

984,547. CENTRAL-ENERGY TELEPHONE SYSTEM. Francis W. Dunbar, Chicago, Ill., assignor to Kellogg, Switchboard & Supply Co. Filed March 22, 1901. Includes a series of relays connected between the talking circuit and a third conductor associated with the cord circuit.

984,558. MOUTHPIECE FOR SOUND-TRANSMITTERS. John Graham, Philadelphia, Pa. Filed April 22, 1910. A light mouthpiece is held by resilient arms to the telephone transmitter in such a way that it is destroyed in the act of removal.

984,559. LIGHTNING-ARRESTER. Edwin R. Harding, Chicago, Ill. Filed July 5, 1907. Two parallel coils are wound on lava cylinders and connected to the line wires. A carbon cylinder conected to ground lies between the two coils.

984,561. LAMP-RECEPTACLE AND HOLDING MEANS THEREFOR. Herman T. Hochhausen, Brooklyn, N. Y. Filed July 25, 1907. Renewed July 15, 1910. A wall receptacle is held by a damping ring from rotating in its supporting plate.

984,564. IGNITION-TIMER FOR INTERNAL-COMBUSTION ENGINES. Laurence B. Holt and Arthur B. Clayton, Laconia, N. H. Filed Jan. 19, 1910. Revolving in a casing is a rotor carrying a plunger which follows a cam path and actuates a contact member.

984,582. ALTERNATING-CURRENT MOTOR. Burton Mc Collum, Lawrence, Kans. Filed Dec. 22, 1909. A squirrel-cage rotor has short-circuiting rings made of tungsten alloy steel, which has high hysteresis resistance and high skin effect at low speeds, and relatively lower hysteresis resistance and skin effect than iron at high motor speeds.

984,587. MEANS FOR PREVENTING ACCIDENTS. Albert J. Meier, Glendale, Mo. Filed Sept. 24, 1909. A magneto is connected to a punch press so as to warn the operator when the die is depressed.

984,603. ELECTRIC WELDING-MACHINE. Lafayette M. Pryor and Jesse L. Trapp, Frankfort, Ind. Filed June 3, 1910. The secondary of a transformer has its conductors in the form of stationary and movable clamps to hold the parts to be welded.

984,651. CONTROL SYSTEM FOR ELECTRIC MOTORS. Arthur C. Eastwood and James F. Schnabel, Cleveland, Ohio, assignors to Electric Controller Manufacturing Co., Cleveland, Ohio. Filed March 18, 1910. A starting, speed-governing and reversing controller for a direct-current motor.

984,655. COMMUTATOR. Friedrich C. Fischer, Philadelphia, Pa. Filed Sept. 8, 1910. A method of repairing, consists in forming an incision in the defective part of the commutator and in applying a correspondingly shaped insert.

984,667. STORAGE-BATTERY ATTACHMENT FOR AIRSHIPS. John W. Hearst, Oakland, Cal. Filed March 17, 1910. A storage battery compartment is detachably secured to an aeroplane.

984,673. CLOTHES-PRESSING TOOL. Thomas M. House, Weldon, N. C. Filed Jan. 12, 1910. A pair of shear-shaped handles is provided with opposed pressing beads, each containing an elastic heating element.

984,677. PLAYING APPARATUS FOR PIANOS AND OTHER MUSICAL INSTRUMENTS. John F. Kelly, Pittsfield, Mass. Filed May 14, 1908. The tone regulating device is electrically controlled.

984,679. AUTOMATIC ADJUSTABLE HOLDER FOR TELEPHONE RECEIVERS. Seward Orton Lancaster, London, Ontario, Canada. Filed March 14, 1910. An adjustable lazy-tongs support is associated with the switch hook so as to hold the receiver at the ear.

984,686. INTERCOMMUNICATING TELEPHONE SYSTEM. Ray H. Manson, Elyria, Ohio, assignor to Dean Electric Co., Elyria, Ohio. Filed May 29, 1907. A main exchange is connected by trunk lines to groups of local intercommunicating substations, each group having an attendant at one of its stations.

984,687. HANGER FOR ELECTRIC LAMPS. Junius Emmett Mayo, Belvidere, Ill., assignor to National Sewing Machine Co., Belvidere, Ill. Filed Jan. 28, 1907. The rising and lowering of the lamp actuates a plunger which makes and breaks the lamp circuit.

984,703. PROCESS OF MAKING SULPHURIC ACID AND ELECTROLYTIC IRON. Alexander S. Ramage, Detroit, Mich., assignor, to National Tube Co., Pittsburg, Pa. Filed Jan. 9, 1909. Renewed July 14, 1910. Consists in dissolving a ferric ore in sulphuric acid, reducing the ferric sulphuric to ferrous sulphate by sulphuric dioxide, electrolyzing the resulting solution in cell provided with a diaphragm and an insoluble anode, and depolarizing the anode by sulphuric dioxide while maintaining the electrolyte in the region of the cathode substantially free from sulphur dioxide.

984,707. VAPOR ELECTRIC APPARATUS. Max von Recklinghausen, New York, N. Y., assignor to Cooper Hewitt Electric Co. Filed Nov. 10, 1903. A mercury-vapor tube is supported from a horizontal bar and arranged to be rotated in starting.

984,712. TROLLEY-RESTORER. William H. Stebbins, Jr., Buffalo, N. Y. Filed Jan. 14, 1910. Is operated by compressed air.

984,719. METHOD OF ELECTRIC WELDING. Elihu Thomson, Swampscott, Mass., assignor to Thomson Electric Welding Co., Lynn, Mass. Filed July 10, 1909. The method of joining the component parts of a metal structure without change of dimension consists in fixing the parts in place in their ultimate relative position, wedging metal adapted to become plastic by heat into a space between the parts at their meeting portions and passing heating electric current from one part to the other.

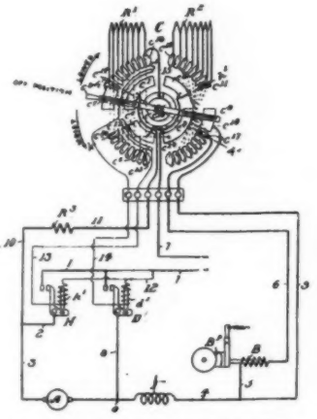
984,738. ANTI-INDUCTION APPARATUS FOR TELEPHONE SYSTEMS. Albert Barrett and William Condon, Kansas City, Mo. Filed Dec. 28, 1908. Combines with a main circuit having a ground return and two branches, inductively related to each other but not to the main circuit, is a variable low resistance transmitter in the main circuit, and a telephone receiver in one branch.

984,748. ELECTROMAGNETIC APPARATUS. John P. Coleman, New York, N. Y., assignor to Union Switch & Signal Co., Swissvale, Pa. Filed Nov. 2, 1910. A signal operating coil, has two E-shaped armatures pivoted at the lower corner. One is arranged so that its motion closes both armatures and the other so that it holds them closed.

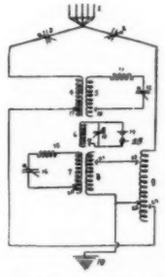
984,759. SWITCH AND FUSE SUPPORT AND COVER. William J. Gibbons, Philadelphia, Pa. Filed July 2, 1910. Has a porcelain base to which the switch and fuse terminals are secured. The cover has recesses and walls to fit around these parts and separate them, and permit circulation of air about them.

984,760. PROCESS FOR PRODUCING ARTICLES BY ELECTRO-DEPOSITION. Frank Irons Gibbs, Birmingham, England. Filed Sept. 23, 1909. The process of forming metallic articles with a bright polished surface consists in electro-depositing metal onto a glazed metallic surface of a pottery-ware or glass model and subsequently removing the model from the deposit.

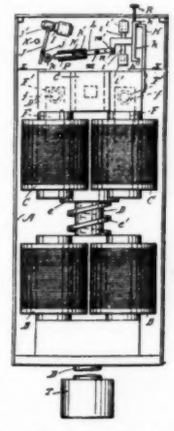
984,762. APPARATUS FOR RECEIVING ELECTRO-MAGNETIC WAVES. Francis A. Hart, New York, N. Y. Filed May 6, 1910. There are two alternative paths from the antenna to the ground, one containing an inductance and capacity and the other having two variable inductances and a capacity.



984,561.—MOTOR CONTROLLER.



984,762.—WIRELESS RECEIVING CIRCUIT.



984,984.—ELECTRIC HAMMER.

984,767. AUTOMATIC TROLLEY-POLE. James W. Lang, Los Angeles, Cal. Filed Aug. 11, 1909. Raising and lowering of the pole is performed pneumatically.

984,769. ELECTROCHEMICAL PRODUCTION OF PHOSPHATIC FERTILIZERS. Giorgio Levi, Rome, Italy. Filed Aug. 14, 1909. Consists in heating in an electric furnace natural tricalcic phosphate, silica in sufficient quantity to displace all the phosphoric anhydride, anhydrous sodium sulphate, and oxide of cobalt, and maintaining the heating of the mass until the phosphoric anhydride has been separated and the residue consists of Saxony blue.

984,771. OUTLET-BOX. Norman Marshall, Newton, Mass., assignor to Arrow Electric Co., Hartford, Conn. Filed June 1, 1909. Has four openings for wires and two crossed conductor bars mounted on an insulating base so as to have the two contact terminals at the end of each bar opposite an opening.

984,802. INSULATED METAL CROSS-TIE. Alva C. Dinkey, Pittsburg, Pa. Filed Sept. 26, 1908. Has a substantial I-beam shaped cross section composed of several parts insulated from each other but mechanically connected.

984,842. APPARATUS FOR OBTAINING PRECIOUS METALS. John R. Parks, Spokane, Wash. Filed June 24, 1907. Consists of a number of electrolytic extraction pans at different levels and connected together in series and parallel. Each pan has a fixed cathode and a removable anode.

984,902. PULL-SWITCH. Gilbert W. Goodbridge, Bridgeport, Conn., assignor to Bryant Electric Co., Bridgeport, Conn. Filed Dec. 14, 1910. In a chain rail for pull switches, means acting on an adjacent ball to hold the end ball of the chain in its socket.

984,905. PROCESS AND APPARATUS FOR THE ELECTROLYTIC DECOMPOSITION OF ALKALINE SALTS. James Green-

wood, London, England. Filed Nov. 22, 1909. The method of decomposing alkaline salts by the diaphragm process consists in producing a partial vacuum in the cathode section.

984,915. DIAPHRAGM CONSTRUCTION. William S. Heltzen, Davis, W. Va. Filed May 19, 1910. The process for the production of diaphragms for electrolytic cells comprises the application of a mixture of lime, cement and pulverized asbestos fiber upon a base composed of asbestos cloth, the diaphragm being then heated until dry, treated with sodium silicate and tempered in water.

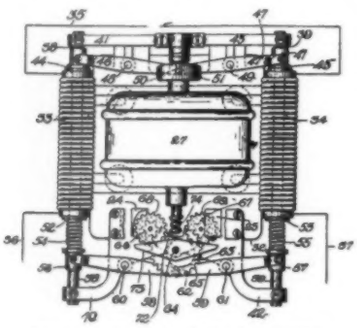
984,925. PROCESS OF OXIDIZING NITROGEN OF AIR BY MEANS OF ELECTRIC DISCHARGES. Karl Kaiser, Wilmersdorf, near Berlin, Germany. Filed March 25, 1910. Consists in adding a small amount of gaseous ammonia to a mixture comprising oxygen and nitrogen, and subjecting the mixture thus produced to the action of an electric discharge.

984,985. TELEPHONE SYSTEM. Oscar M. Leich, Genoa, Ill., assignor to Cracraft-Leich Electric Co. Filed Nov. 13, 1909. A magneto system.

984,958. TELEPHONE-EXCHANGE SYSTEM. Jay Gordon Mitchell, Cleveland, Ohio, assignor to North Electric Company, Cleveland, Ohio. Filed July 15, 1909. Relates to the signaling between the A and B operators.

984,970. FURNACE FOR METALLURGICAL PURPOSES. Wilhelm Rodenhauser, Völklingen, Germany, assignor to Gröndal Kjellin Co., London, England. Filed Nov. 3, 1908. An electric furnace has main electrodes for heating the charge and an auxiliary circuit below the surface of the charge for supplying heat uniformly throughout its mass.

984,984. ELECTRIC HAMMER. Hilary F. Whalton, Key West, Fla. Filed May 26, 1910. Consists of two pairs of electromagnets, the lower stationary and the upper reciprocable. To the upper is secured a hammer shaft. Attractions of the mag-



985,109.—VOLTAGE REGULATOR.

nets on closing the circuit actuates the hammer; on breaking the circuit a spiral spring forces the upper magnet and hammer up.

985,009. VARIABLE SELF-INDCTION COIL. Allyne Clark Hovey, Pittsburg, Pa., assignor of thirty one-hundredths to Walter Rosenbaum and thirty one-hundredths to Herman S. Heymann, Pittsburg, Pa. Filed Oct. 20, 1909. A coil is mounted over one leg of a V-shaped iron core so that it can be raised and lowered by means of a screw.

985,011. GAS-ENGINE STARTER. Charles E. Daniels and Ellsworth S. McNichols, Atchison, Kans. Filed Dec. 27, 1909. Includes separate circuit closers and auxiliary means for operating them for initial ignition.

985,018. BATTERY LAMP-SOCKET. George N. Eastman, Riverside, Cal., assignor to Eugene C. Brown, Washington, D. C. Filed March 23, 1909. The socket has an extension adapted to engage the carbon terminal of a dry cell and a flexible wire to connect to the zinc binding post.

985,021. ANTISEPTIC TELEPHONE-MOUTHPIECE. William M. English, Sausalito, and Louis E. Boukofsky and Solomon M. Lichtenstein, San Francisco, Cal. Filed Aug. 29, 1910. A holder for an antiseptic liquid and for absorbent cotton is attached to the inner end of the mouthpiece.

985,024. TELEPHONE CURRENT-SELECTOR. Eugene Garretson, Buffalo, N. Y., assignor to Christopher H. Bierbaum, Arthur L. Fox, and Geo. H. Calkins, Buffalo, N. Y., George R. Fuller and J. W. Morrison, Jr., Rochester, N. Y., and Harold F. Hayes. Filed May 5, 1908. In series with the bell is a resistance unit composed of argentite which has a negative temperative coefficient and therefore has a high resistance at low potential but permits a heavy current to flow when the potential is raised.

985,029. COMBINED HOSE-REEL, AUTOMATIC WATER-DISCHARGER, AND FIRE ALARM. Adolph A. Hein, Charleston, Wash., Filed Feb. 8, 1910. When the reel is rotated a valve is automatically opened, admitting water to the hose and at the same time closing an alarm circuit.

985,045. SEPARATOR FOR SECONDARY STORAGE BATTERIES. Albert F. Madden, Newark, N. J., assignor to Electric Storage Battery Co., Philadelphia, Pa. Filed March 7, 1908. Consists of a sheet having a number of parallel closely spaced slits cut through it with the portions of the sheet between the successive slits offset.

985,069. AUTOMATIC SWITCH. John B. Schug, Detroit, Mich. Filed June 26, 1908. The pulley on the shaft of a magneto has a centrifugal governor which shifts a contact lever and thus closes the circuit switch when the shaft attains a certain speed.

985,082. RECHARGEABLE SAFETY-FUSE. Hugh Wallace and Frank A. Swanson, Chicago, Ill. Filed May 7, 1910. An inclosed fuse has the fusible element arranged so it can be secured between two terminal plugs that are screwed to the end caps of the casing.

985,083. ELECTRIC FURNACE. Eugene Wassmer, London, England. Filed Dec. 10, 1910. Comprises an arc chamber, a pair of electrodes, two incandescers in the shape of perforated grids between the electrodes to spread the arc widely and to form separate jets or flames, and a reaction chamber between the grids.

985,092. INSULATED RAIL-JOINT. Benjamin Wolhauppter, New York, N. Y., assignor to Rail Joint Co., New York, N. Y. Filed June 18, 1907. Has a separate base plate and auxiliary side rail insulated from the main rails.

985,101. PUSH-BUTTON. Charles Auth, New York, N. Y. Filed Dec. 18, 1909. The stem of the button completes the circuit between two spring contact members.

985,109. AUTOMATIC VOLTAGE-REGULATOR. George A. Burnham, Essex, Mass., assignor to Sarah B. Condit, Jr., Boston, Mass. Filed Aug. 23, 1909. Associated with the field circuit of a generator is a compression resistance member, means for rapidly fluctuating the resistance thereof, and automatic means for intermittingly changing the resistance.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired February 27:

515,342. ELECTRIC ARC LAMP. George Kirkegaard, Brooklyn, N. Y.

515,366. ELECTRICAL RAILWAY SIGNAL. Henry V. Riley and Charles Selden, Baltimore, Md.

515,374. ELECTRICAL CONTROLLER. Elmer A. Sperry, Cleveland, Ohio.

515,386. DYNAMO-ELECTRIC MACHINE. Jonas Wenstrom, Orebro, Sweden.

515,397. ELECTRIC GAS-LIGHTER. John O. Dahlgren, Boston, Mass.

515,401. ELECTRIC HEATER. Austin S. Hatch, Windsor, Canada.

515,439. TOY OR TRICK DEVICE. Albert D. Mountain, Philadelphia, Pa.

515,448. FIXING ELECTRIC CONDUCTING WIRES TO INSULATORS SUPPORTING SAME. Rudolf Schomburg, Berlin, Germany.

515,465. ELECTRICAL GLOW-LAMP. Herbert Cottrell, Newark, N. J.

515,467. ARMATURE FOR ELECTRIC MACHINES. Wlademar Fritsche, Berlin, Germany.

515,473. REGULATOR FOR CONTINUOUS-CURRENT ARC-LIGHT CIRCUITS. Daniel Higham, Boston, Mass.

515,478. BOND FOR ELECTRIC RAILWAYS. Julius Meyer, New York, N. Y.

515,484. SOCKET FOR INCANDESCENT LAMPS. Louis Stirn, New York, N. Y.

515,502. SECONDARY BATTERY. Leslie B. Rowley, Ashland, Wis.

515,503. AUXILIARY FIRE-ALARM TELEGRAPH SYSTEM. Joseph Sachs, New York, N. Y.

515,531. SWITCH AND CIRCUIT FOR TELEPHONE-EXCHANGES. Joseph J. O'Connell, Chicago, Ill.

515,572. CONDUIT ELECTRIC RAILWAY. Joseph A. Cassidy, and William A. Butler, New York, N. Y.

515,589. SIGNALING APPARATUS. Oscar D. Kleinsteuber and Monroe A. Kleinsteuber, Milwaukee, Wis.

515,606. INCANDESCENT LAMP SOCKET. Rufus C. Nourse, South Framingham, Mass.

515,613. CURRENT-COLLECTOR FOR DYNAMOS. Charles R. Roberts, Addison, Pa.

515,638. ELECTRIC-ALARM SYSTEM FOR RAILWAY CROSSINGS. Adoniram J. Wilson, Port Chester, N. Y.

515,648. AUTOMATIC ELECTRIC RAILWAY SIGNAL SYSTEM. Charles P. Breese, New York, N. Y.

515,652. APPARATUS FOR ELECTRICALLY HEATING OR WORKING METALS. Charles L. Coffin, Detroit, Mich.

515,654. ELECTRIC RAILWAY. Benjamin F. Comstock, Decatur, Ill.

515,665. SIGNALING APPARATUS. James W. English, New York, N. Y.

515,693. ELECTRIC HEATER. Samuel E. Nutting, Chicago, Ill.

515,709. TELEGRAPHIC INSTRUCTOR. Thomas J. Houck and Harrison M. Browning, Baltimore, Md.